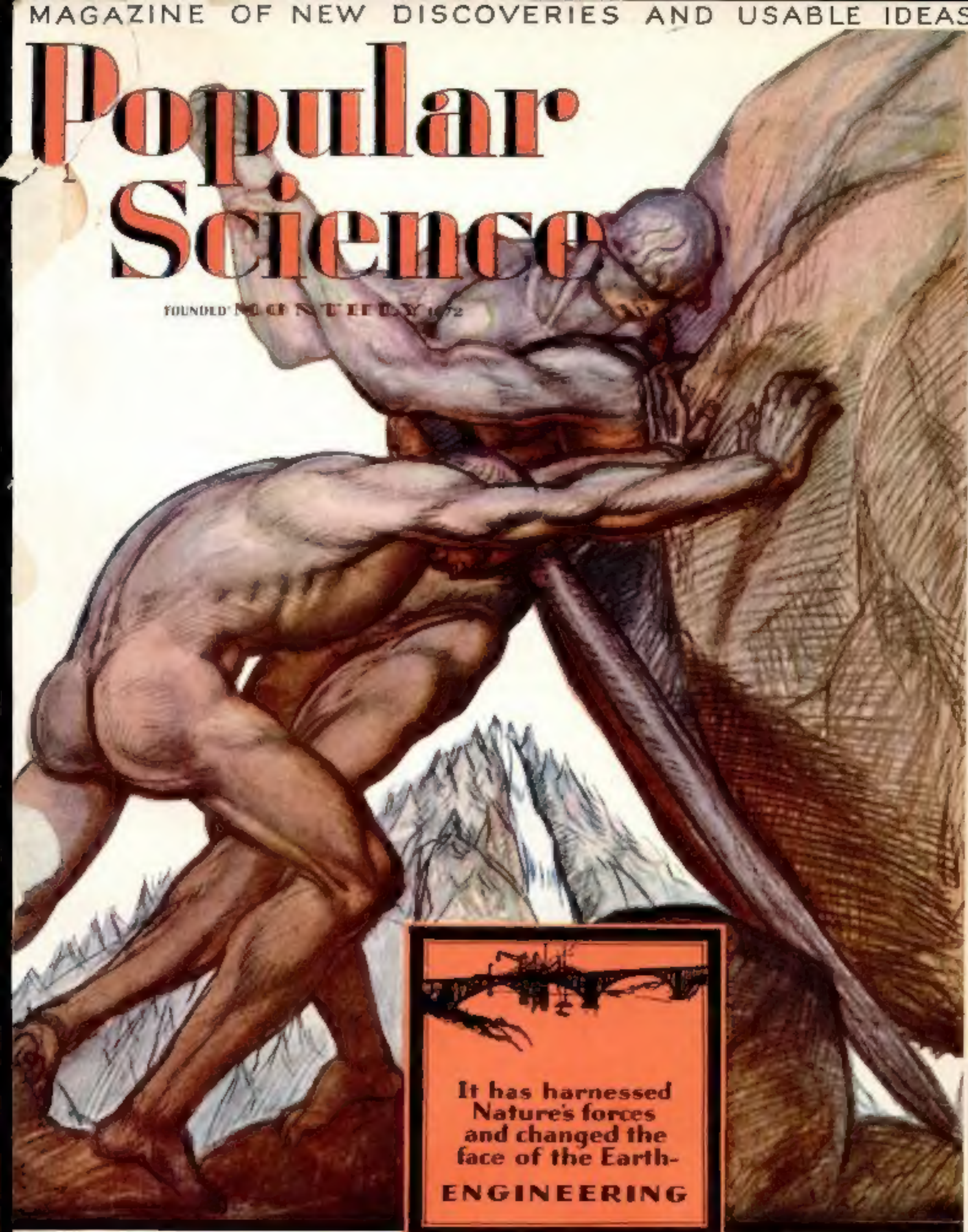


MAGAZINE OF NEW DISCOVERIES AND USABLE IDEAS

Popular Science

FOUNDED NOVEMBER 1872



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3 Every used car is conspicuously marked with its price in plain figures, and that price, just as the price of our new cars, is rigidly maintained.

The public can deal in confidence and safety only with the dealer who policy is "New price unless the value goes up 10%". For, no self-respecting dealer, party one of them, would be likely to sell at a higher price.

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Not only to the public, but also to The Studebaker Corporation of America, whom cars we sell, we pledge adherence to the above policy in selling used cars.

Your Studebaker Dealer

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S T U D E B A K E R



STRIKING NEW FEATURES IN THIS ISSUE

WITH this issue POPULAR SCIENCE MONTHLY appears in a new dress. New features, a greater diversity of material, and the first of a notable new series of cover designs all contribute to make it "the most interesting magazine in the world." No other magazine is quite like it. None has its infinite variety, its provocative charm and its tremendous personal value.

Dedicated more than a half century ago to the service of folk who demand more than a casual knowledge of the amazing achievements that are constantly changing our lives, POPULAR SCIENCE MONTHLY always has proved worthy of its heritage—always has moved forward with the times.

Improvements and changes have kept us youthful and vigorous. And so with all of the features continued that have made POPULAR SCIENCE MONTHLY famous, and new and fascinating ones added, we feel that this issue marks the beginning of the most brilliant period in our history.

THE striking painting reproduced on our cover is the first of a remarkable series of covers each of which depicts the *spirit* of some field of science. This month's cover is by Frederico LeBrun, distinguished Italian artist, whose work is attracting widespread interest. No magazine has ever published anything like this series of covers.

In this issue also, we publish fiction for

the first time. This expansion of our editorial plan is undertaken in the belief that in this way we can best preserve the qualities of human appeal in presenting to our readers some phases of the tremendous drama of science, and its effect on our lives.

On page 14 you will find the first installment of "Bare Hands," Hawthorne Daniel's new novel, and on page 30 "Midge," a short story by Edmund M. Littell. We have been gathering a brilliant group of stories—stories vibrant with life and written with authority—and will publish them in POPULAR SCIENCE MONTHLY from month to month.

BEGINNING in this issue, also, is Frank Parker Stockbridge's remarkable story of Glenn Curtiss, one of the most amazing men in America today. It is nearly a year since the editors of POPULAR SCIENCE MONTHLY asked Mr. Stockbridge to prepare this series. The quest of it has taken him from Canada to Florida, through a hurricane and a motor wreck. But when you read it, you will agree that it is worth the effort.

In planning this issue and those that are to come, we have had the aid of leading experts in making the magazine more beautiful and easier to read. The arrangement of every picture and the selection of every bit of type have been considered carefully that we might make POPULAR SCIENCE MONTHLY more intensely human, more vital to you.—S. N. B.

March, 1927, Vol. 110, No. 2. Popular Science Monthly is published monthly at 230 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Chicago, Illinois, E. term as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright 1927, by the Popular Science Publishing Co., Inc. Single copy, 25 cents. Yearly subscription in

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Add the new Balkite Combination



U. S. PATENT, OCT. 12, 1926

to your radio set now

with your "A" battery it supplies
all radio power automatically from
the light socket



Three New Balkite "B"s

Balkite "B" eliminates "B" batteries and supplies "B" current from the light socket. Three models. Balkite "B"-W at \$17.50 for sets of 3 tubes or less requiring 67 to 90 volts. Balkite "B"-X (illustrated) for sets of 8 tubes or less capacity 30 milliamperes at 135 volts—\$42. Balkite "B"-Y for any radio set capacity 40 milliamperes at 150 volts—\$69. (In Canada: "B"-W \$19; "B"-X \$59.50; "B"-Y \$96.)



The New Balkite Trickle and High Rate Charger

Has a low trickle charge rate and a high rate for rapid charging. Can thus be used either as a trickle or as a high rate charger. Noiseless. Rates: with 6-volt battery, 2.5 and .5 amperes; with 4-volt battery, .8 and .2 ampere. Price \$19.50. (West of Rockies \$20. In Canada \$27.50.)



Balkite Trickle Charger, \$10

For those who require a charger of limited capacity only. Can be left on continuous charge thus automatically keeping the battery at full power. Over 300,000 in use. Rate .5 ampere. Price \$10. (West of Rockies \$10.50. (In Canada \$13.)

All Balkite Units operate from 110-120 volt, 50-60 cycle AC, except the Balkite Charger which is also made in 25-40 cycle model.

Now you can operate your radio set from the light socket, merely by adding the new Balkite Combination Radio Power Unit. Once connected to your "A" battery and set and plugged into the light socket, it supplies automatic power to both circuits. You need not even turn it off and on for it is controlled by the filament switch already on your set. Whenever you turn on your set you will find Balkite Combination always ready to operate with full even silent power. It will give a constant quality of reception that cannot be secured in any other way.

Balkite Combination can be installed in a few minutes.

Like all Balkite Radio Power Units it has no tubes, nothing to replace or renew, and is a permanent piece of equipment that will serve you not only this year, but for years to come. It is noiseless in operation. It serves any set now using either 4 or 6-volt "A" batteries and requiring up to 30 milliamperes at 135 volts of "B" current—any set of 8 tubes or less, including power tubes.

Add Balkite Combination to your radio set and know the pleasure and convenience of owning a set always ready to operate at full power.

Price \$59.50. [\$83 in Canada.] Ask your dealer. Fansteel Products Co., Inc., North Chicago, Ill.

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Every other Saturday night a symphony concert. On alternate Saturdays one of Mr. Damrosch's famous piano recitals. Over stations: WEAF, WEEL, WGR, WFI, WCAE, WSAI, WTAM, WWJ, WGN, WCCO, KSD, WDAF, WOC, WCAP.

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SATURDAY EVENINGS
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THE BALKITE LINE OF ELECTROLYTIC DEVICES IS PROTECTED BY

EDGAR W. ENGLE U. S. PATENT NO. 18,428, DATED OCT. 10, 1926



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Tycos Office Thermometers

An aid in promoting human efficiency.

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To enable you to get the most good from your bath.

Tycos Home Set

Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

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To help you maintain a temperature in your house conducive to good health.

Tycos Quality Companies

To show you the right way in unfamiliar country.

Tycos Fever Thermometers

A necessity in every home.

Tycos Stormguide

Forecasts the weather twenty-four hours ahead with dependable accuracy.

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To enable you to keep the humidity of the atmosphere in your home correct at all times.

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Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above.

Write for Bulletin

ONE bread baker serving 30,000 customers a day says that Tycos Instruments have helped materially in building up one of the largest retail bakeries in the world—temperatures are controlled exactly—a necessity in baking good bread. Tycos Instruments, the Sixth Sense of Industry, make possible a better product and at a lower cost of production—for this one company Tycos Instruments “pay for themselves many times over each year.”

Not only are Tycos Instruments saving money in manufacturing where heat processes are used but what is even more important to manufacturers their use insures a uniform quality of product—the reduction of wastage in manufacturing and the satisfaction of the dealer and ultimate consumer.

Whether you make steel or bread, furniture, ice cream, tools, candy, or any other product that goes through manufacturing processes that require the indicating, recording or controlling of temperature, there is a type and style of instrument in the Tycos line of 8,000 varieties that will help you. Informative literature on any type of instrument will be sent you promptly on request. Or our engineer will consult with you on the application of Tycos to your particular manufacturing problem.

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SEEING MORE THAN THE MICROSCOPE

Electrons, which are very important in radio, are too small for any microscope to make visible. Yet our eyes can watch their paths—study their habits.

In the laboratories where Radiotrons are studied there are instruments which make all these things possible—and more. Knowing how many electrons leap across from the filament to the plate of a vacuum tube is in its way as abstruse a study as the measurement of distant stars by astronomers. Yet this abstruse research has a definite application in the RCA Radiotron in your radio set. That is why the laboratories back of RCA spend millions in scientific research that is far too much like "pure science" for an ordinary manufacturer.

Radiotrons are improved and new ones are developed, to make radio better. Because this research shows in results, Radiotron users keep five great factories busy!

Watch your tubes, always, for the RCA mark. You will find it on Radiotrons for every purpose.



clear up the tone

Do you get a blast when you turn the volume up a bit? Do you get sweet, clear tone at low volume, but noise when it's louder? The trouble's probably right in one tube—the tube in the last audio stage. The Radiotron laboratories discovered that no ordinary tube can let big volume through clearly. Change one tube to an RCA power Radiotron. Then turn up the volume . . . and it comes through *clear!*

Bring your storage battery set up-to-date with
a power RADIOTRON UX-171 or UX-112
a detector RADIOTRON UX-200-A
and RADIOTRONS UX-201-A for all-round quality.

Bring your dry battery set up-to-date with
a power RADIOTRON UX-120
and RADIOTRONS UX-199 for all-round quality.

RADIO CORPORATION OF AMERICA - NEW YORK - CHICAGO - SAN FRANCISCO

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA

At 34 GEORGE SCOTT Is Planning To Be *Financially Independent* at 54

By WALLACE AMES, *Financial Editor*

GEORGE SCOTT is now 34 years old, married, the father of three little girls, and holds an executive position with a large public utility organization. Let Scott tell in his own words how he is looking ahead and planning ahead financially:

"As I was married soon after leaving college my outlay for living expenses was quite rapidly on the upgrade for several years. But fortunately I had gotten into just the kind of work I was suited for and my advancement in business responsibility and in income kept pace with my increasing needs. But I didn't lay by much of anything until after my youngest daughter was past a year old.

"Two years ago my wife and I laid out a program to 'peg' our normal living expenses at about what they were then running and set down a definite program to take care of us and our children in later years.

"There were two things that influenced me to do this. Of course, one was the realization that I owed a responsibility to my wife and family beyond merely providing them with a good living as we went along. The other was the fact that in all likelihood my best earning years were the fifteen or twenty immediately ahead and that was the time to provide for years of possibly declining earnings and years of retirement.

"If all goes well I will keep on advancing my income for the next fifteen years at least. And the plan my wife and I are carrying out will enable us during those years of peak earnings to buy years of independence later on.

"**I**N WORKING out our plan I got the assistance of a firm of investment bankers. When I first went to them I put all the cards on the table. I had heard that they made it a point to give real personal service to their investment customers and I wanted them to know the circumstances with which I had to work so that they could give my case the right kind of treatment.

"Of course I do not know how much money I am going to make in the future. So the plan we adopted may be changed from time to time. But we did have some definite facts to go

on and the program is based on them.

"In the first place, after carefully budgeting our family expenses we found out that we could maintain a satisfactory standard of living on \$4,200 a year. Therefore, when I am ready to retire I want to have at least \$4,200 a year of independent income.

A New Service

for Readers of

POPULAR SCIENCE MONTHLY

THIS new Department is to help readers in the establishment of proper financial programs at the beginning of their business careers; it assists those who have accumulated money in the proper investment of it so that it will be safe and so that it will grow.

The Editor of this Department is an authority on investment matters and he will not only every month give the readers interesting and useful information in his articles, but is also ready to aid in personal investment problems. Advice will be gladly given regarding the proper investment of funds and proper plans of saving.

Address all your inquiries to Wallace Ames, Financial Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York.

Any advertising appearing in this section will be carefully investigated by the Publisher of POPULAR SCIENCE MONTHLY. Readers can be sure that companies advertising are reliable and that they offer securities which represent sound financial investments. While investments obviously cannot be guaranteed by the Publisher, every effort will be made to insure that only advertisements of absolutely reliable companies are accepted.

"In the second place, it will take \$70,000 at 6% to bring in an annual independent income of \$4,200. To be on the safe side we set my goal at \$75,000 and determined to reach it in not more than twenty years. The firm of investment bankers who helped lay out the plan showed me some figures. According to them, if I invested \$162.93 monthly at 6% and reinvested the interest at the same rate I would have \$75,000 in 20 years.

"That meant saving and investing \$1,955.16 yearly. At the time we started the plan my income was \$6,000 which after taking out \$4,200 for living expenses did not leave quite enough. But my wife and I were anxious to get started at once so we re-budgeted our expenses to fit the new program. That was two years ago. Now my income is \$7,500. We have boosted our expense budget to \$4,500 and still have about \$1,000 a year surplus in addition to keeping up the monthly investment of \$162.93.

"In a few years we will probably put our surplus into a home, and I have already increased my line of life insurance, but whatever else we do we intend to let nothing interfere with getting that \$75,000 in twenty years."

IN PRINCIPLE there is nothing about the George Scott plan that any man or woman cannot follow. And how much more sensible, how much more comfortable it is to direct one's financial progress by some such long-term plan than to drift along with little or no plan at all.

Any reliable investment banker stands ready to assist in developing a schedule to achieve the desired result through monthly, semi-annual or annual investment of a definite sum.

Naturally the longer the planned period of investment the smaller the annual sum necessary to gain the objective. For example, by investing \$108.91 per month George Scott could reach his objective of \$75,000 in 25 years instead of in 20. Or by investing \$258.22 monthly his goal could be reached in 15 years.

NOT everyone needs, or can accumulate \$75,000. But the plan works just as well in any other amount. For instance, \$60.66 invested monthly at 6% and interest reinvested promptly becomes \$10,000 in ten years. Or, making the monthly investment the round sum of \$60, in ten years the investor would accumulate \$9,842.62. Over one fourth of this amount would be interest; only about three quarters of it money actually saved out of earnings.

The average individual has a better opportunity today than ever before to get himself on a solid financial basis. And the wisest men and women will follow a consistent, long-term plan aimed at a definite goal.

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This is the Burgess Radio "A" Battery

A SPECIALLY designed "A" battery for radio service. There is nothing like it in its field.

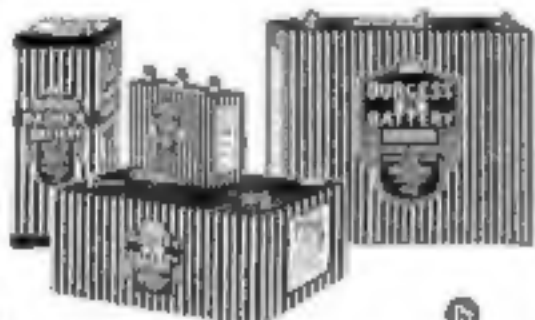
Proportioned to permit ease of handling and convenience of cabinet assembly and storage, you may expect this new Burgess creation to give you the length of service and dependability under all conditions for which all products of Burgess are noted.

If you are using the ordinary type of No. 6 "A" battery, we suggest that you learn for yourself from the Burgess Radio "A" the measure of service you have a right to expect.

Ask Any Radio Engineer

BURGESS BATTERY COMPANY
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BURGESS

RADIO BATTERIES

Booklets Like These Helped George Scott

ANYONE with money available for investments will find the booklets listed below of help in getting ahead financially. You may obtain any of these booklets by writing direct to the issuing house. It will be appreciated if you will mention POPULAR SCIENCE MONTHLY when writing for booklets.

How to Build an Independent Income (1927 Edition)—Describes a plan for buying 6½% First Mortgage Bonds by payments of \$10 or more a month, and shows the results that may be accomplished by systematic investment at 6½%. For copies address: The F. H. Smith Company, Smith Building, Washington, D.C.

Why Your Real Estate Bonds Should Be Guaranteed is the self-explanatory title of a booklet on a subject of wide interest among investors in Real Estate bonds. Address: Adair Realty & Trust Co., Healey Building, Atlanta, Ga. Ask for Booklet P.S.-1.

Forty-four Years Without Loss to Any Investor presents the safety record of this house and describes the safeguards constituting the Straus Plan. Address: S. W. Straus & Co., Desk P, Fifth Avenue & 46th Street, New York, N. Y.

Safe Bonds for Investment presents their current list of diversified investment offerings, with instructive investment comment. Address: Halsey, Stuart & Co., 101 South La Salle St., Chicago, Ill. Ask for booklet P.S.-B.C.

The Making of a Good Investment explains the methods employed by the United States Mortgage Bond Co. in originating first mortgage bond issues which pay 6½% with principal and interest guaranteed, or 6½% without the guarantee, which is optional with the investor. Address: United States Mortgage Bond Company, 365 U. S. Mortgage Bldg., Detroit, Mich.

An Investment Insured for Its Lifetime describes a plan of insured mortgage investments. Nine points of safety are explained. Address: Mortgage Security Company of America, Norfolk, Va.

Rules for Safe Investments explains in language that the layman can understand the important factors of safety of real estate bonds. Address: American Bond & Mortgage Company, 145 Madison Avenue, New York, N. Y., and ask for Booklet P. S. 40.

Buying Bonds by Mail explains how the investor may safely and conveniently deal with an investment banker through the mails, and without the usual advantage of direct contact. Address: A. C. Allyn & Co., 67 West Monroe Street, Chicago, Ill. Ask for Booklet D.E.-2450.

Your Money covers the points of general interest to the investor who is planning to put his money in sound mortgage bond investments. Address: Fidelity Bond and Mortgage Co., 1188 New York Life Bldg., Chicago, Ill.

How to Analyze a First Mortgage Real Estate Bond Issue is the self-descriptive title of a booklet published by the Federal Bond & Mortgage Co., 1444 Griswold Street, Detroit, Mich.

The Science of Fortune Building, published by George M. Forman & Co., is the explanation of practical, tested plans employed by investors to attain financial independence. Address: George M. Forman & Co., 164 West Monroe St., Chicago, Ill. Ask for Booklet 833.

Investors' Guide, published by Greenbaum Sons Investment Company, combines a description of "bank safeguarded" bonds with an outline of the service of that company. Address: Greenbaum Sons Investment Co., 9 So. La Salle St., Chicago, Ill.

Two New Booklets to Help You

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FOR more than half a century The F. H. Smith Company has been helping men and women to invest successfully; to protect the money they have accumulated, and to make their invested savings produce a continuous and substantial income. The uniform success of these investors is evidenced by our record.

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whether you invest
much or little

Smith Bonds, in \$1,000, \$500 and \$100 denominations, are sold outright for cash, or under an Investment Savings Plan that pays the full rate of bond interest—6½%—on regular monthly payments of \$10, \$20, \$30, \$40, \$50 or more.

Our booklet, "How to Build an Independent Income," enables you to look forward 5, 10, 20 years or more, and see the amount you can accumulate by investing your monthly savings at 6½%.

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The DANGER of MISUSING TOOLS

FROM the standpoint of economy and efficiency, most men appreciate the importance of buying good tools. But safety is a factor that is seldom considered, and yet it is of vital importance to every user of tools. And using a monkey wrench as a hammer, a screw driver as a lever, or a hammer as a mallet in chiseling may result in accidents to the user—and is sure to ruin the tool.

The fact that 3,868 compensated accidents in one state (New York) in one year were caused by the misuse of hand tools or defects in such tools is proof of the actual danger of using poor tools. Robert Northrup, in the Industrial Hygiene Bulletin, says:

"A cheap tool is prone to be an unsafe tool. Purchase tools from those concerns who are making every effort to produce the highest standards in their departments—where the steel to be selected for various tools and its best method of tempering is studied, and where the finished product is tested under practical working conditions."

The Popular Science Institute of Standards is doing just this work that Mr. Northrup refers to—subjecting hand tools to exacting tests that bring out their merits or demerits. A tool that bears the seal of approval of the Popular Science Institute is a good tool of proper design, material and construction. It represents good value. It will stand up under usage. And it is as safe as well as an economical and efficient tool to use.

THE Institute's tests not only determine the performance of tools under ordinary usage, but also under abuse. The abuse of tools is so prevalent that the Institute has found it absolutely necessary to allow for this in determining whether or not a tool will give satisfaction.

But this matter of abusing tools is a serious one and should receive consideration by every man who uses tools—whether he be a home workshop "tinkerer" or a professional carpenter or mechanic. It might be thought that the former would be the habitual offender in the matter of misusing tools, but this is not the case. There is just as much abuse and poor selection of tools by professionals as by the man who only uses tools occasionally. For instance, Mr. Northrup brings out in his article the following case:

A number of accidents occurred to a



By Prof. Collins P. Bliss

Director, Popular Science Institute of Standards,
Head of Dept. of Mechanical Engineering
and Director of Testing Laboratories,
New York University



group of twenty workmen. All were caused by the setting hammers used for hand riveting. These would chip off and cause serious injury, one employee suffering two different injuries from this cause. Nearly every hammer in the shop proved to be too hard and showed chipped faces. One was found so soft that it proved useless for riveting. These two phases showed laxness in the making of the ham-

mer, in the character of steel used and methods of tempering. This all could have been avoided by the selection of hammers that were made of that character of steel and tempered and drawn to a point where they would be as efficient a riveting device as possible, and not chip off.

A POINT to be kept in mind is that a refined tool cannot be used for unrefined action without serious results. Where proper use demands a brittle edge or surface, that tool should never be used where there is any impact. If it is so misused, it is very possible that the tool will chip and the steel will fly up and enter the user's eye. This same tool, properly used for the purpose intended, would be absolutely safe and satisfactory.

One of the chief causes of the misuse of tools is getting accustomed to using cheap tools. The man who is educated on cheap tools almost invariably becomes accustomed to the wrong method of use.

Aside from the misuses listed above, there is a rather prevalent custom of using pliers as a hammer—home workshop owners are the particular offenders in this regard, but other workmen are often found to be capable of the same trick.

Using a screw driver as a crowbar is another offense commonly committed, also using cutting tools on surfaces they are not made for. The damage done by such misuse is generally to the tool itself, but now and then the user—or rather misuser—comes in for his share of punishment.

The advice that the Popular Science Institute of Standards offers to every user of tools—professional or amateur—is that (1) he buy good tools, (2) that he have a complete enough kit of tools for all kinds of work he may do, and (3) that he use these tools correctly for the purpose intended and no other.

In the first regard, Popular Science Institute is prepared to offer concrete assistance in the way of recommendations of good tools. These recommendations are based on the results of extensive laboratory and practical tests that bring out the actual worth of the tools.

A list of those tools that have been approved after test can be obtained on request from the Popular Science Institute. Similar information is available on radio equipment and oil burners. Address inquiries to the Popular Science Institute of Standards, 250 Fourth Avenue, New York, N. Y.

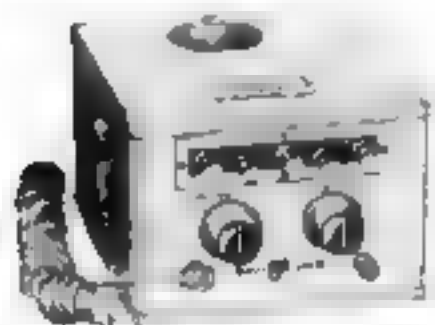
Popular Science Monthly GUARANTEE

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POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by POPULAR SCIENCE MONTHLY. THE PUBLISHERS



The one illustrated is All American
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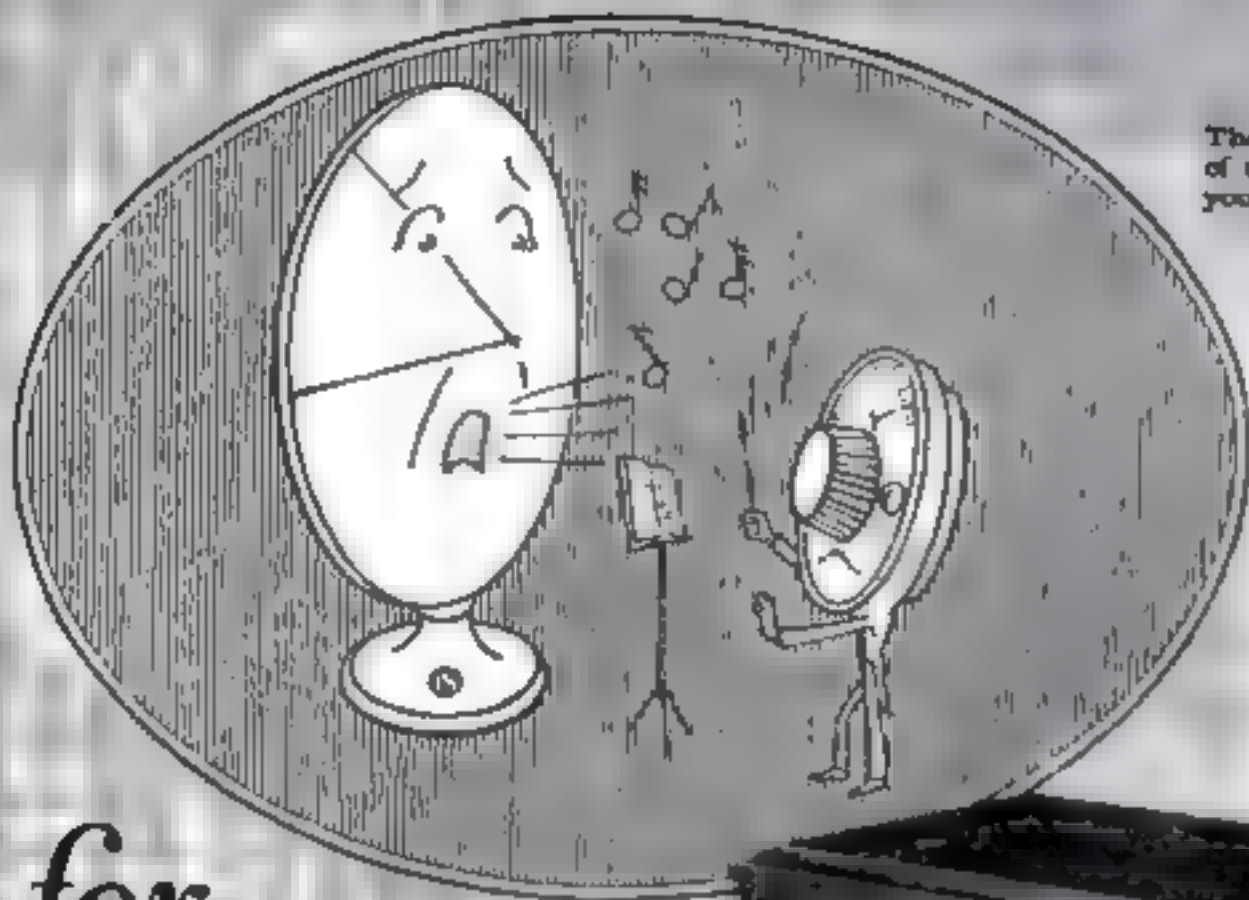
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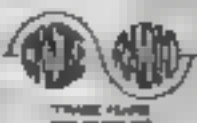
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POPULAR SCIENCE MONTHLY

SUMNER N. BLOSSOM, Editor

March, 1927



Typical scene at one of the great South Africa diamond mines

Crystals of Fire!

The Magic Story of Diamonds, and How Men Stampede for the Fabulous Wealth Hidden in Glistening Pebbles

By EDGAR C. WHEELER

DIAMONDS! On the parched soil of a lonely western Transvaal farm in South Africa a few months ago a motley throng of fifteen thousand souls stood in restless line that stretched for two miles across the veldt. Eagerly they waited, eyes fixed on a small signal flag that hung from the top of a bamboo pole—waited for the signal which would send them in a mad rush for sparkling gems, like street urchins scrambling for pennies. Somewhere, in the broad fields before them, lay kingly wealth in white crystals, dizzy fortunes for the lucky finders.

For days the fevered crowd of diamond hunters had been awaiting this breathless moment. For days—ever since the government had proclaimed the unprofitable farm of Elandsputte a free-for-all diamond field and had set a time for pegging—adventurous gamblers for quick wealth had been arriving from the corners of the earth.

Dust clouds had hung like a pall



Two views of the original Cullinan diamond, largest ever found. It weighed 3.37 pounds



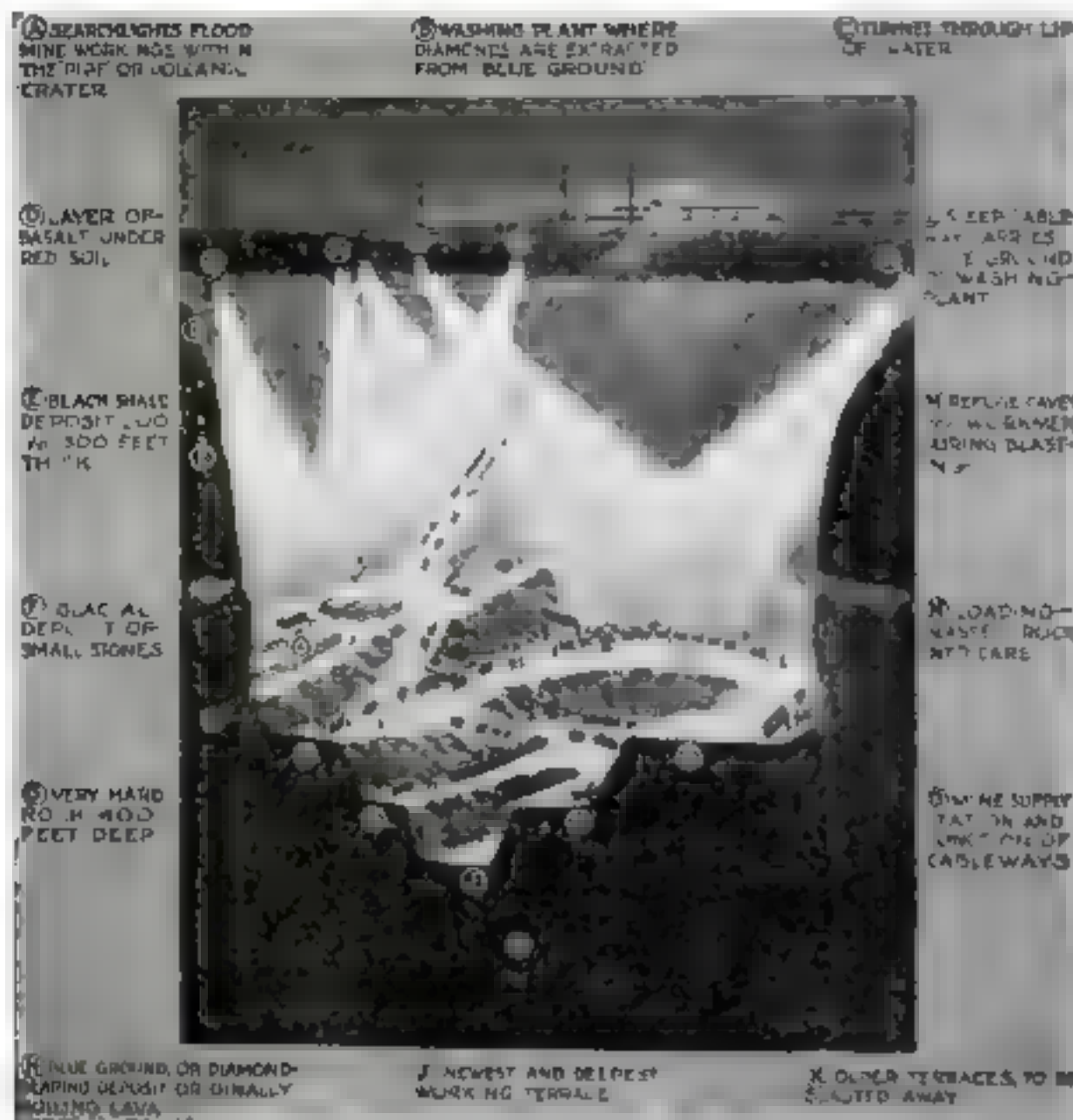
Nine gems of rare beauty cut from the famous Cullinan stone, which was presented to King Edward VII

over roads cluttered with vehicles, from automobiles to ox-carts. In the throng were farmers with their families and household effects, business men, mechanics, college students, vagrants, hardened prospectors, black Kaffirs, sailors, war veterans, shop girls—all drawn from the everyday hum-drum of life by the witchery of precious jewels.

And now they stood in line, ten deep in some places, impatient for the signal, each holding in his hands four marking pegs with which to stake his little claim. Here and there among them were athletes in running shorts and spiked shoes, hired for their fleetness of foot by financiers and diamond syndicates.

THE government's mining commissioner looked at his watch. It was noon. A pistol barked. The signal flag dipped.

Diamonds! The thousands surged over the line, racing toward the field of gems a mile or so away—panting, stumbling for the lead—old and



How a great diamond mine like the Premier mine in South Africa is operated. Power lights are used at night for working at depth. The waste stones are removed from blue ground at the bottom of the shaft by a hoist, taken to a shed where the volume of the which reaches to unknown depths. Cableways lead the blue ground to a washing plant at the surface where the gems are extracted.

young rich men and beggars, black and white. First to reach their goal were the trained athletes. Quickly they pegged their claims on the most promising locations. Close behind came a little dark-skinned girl, running for her father. Then the mob, scrambling better sweater for what was left. And last of all, the wives and children, their arms loaded with household effects. Before nightfall, as if by magic, a desolate Transvaal farm had been transformed into a bustling camp, as wild and thrilling as any gold camp of the Klondike or of California in the days of '40.

SO BEGAN the famous Elandsputte diamond stampede which echoed around the world and added one more fascinating chapter to a story more romantic than any imaginative tale of fiction—the story of the stones of fire.

Alluvial sand and gravel, deposited in ages past, gave up their hidden jewels in generous store to the Elandsputte diggers—hundreds of thousands of dollars' worth. The lucky reaped fortunes overnight. Within a dozen weeks the first rickety camp grew to a mining town of more than 30,000 souls.

So rich were the finds that before long the rumor went out that the new supply threatened to glut the diamond market and reduce the most desired of gems to a commonplace. To add weight to these rumors, at the height of the Christmas

shopping season, came news from England that the beautiful, amber-hued Golden Dawn diamond, previously valued at \$200,000, had been sold in Christie's auction rooms in London for the mystifyingly low sum of \$24,057. This flawless sixty-one-and-one-half-carat beauty, discovered near the famous Kimberley mines in 1913 by a British soldier, Captain C. R. Lucas, had gone under the hammer to the fabulously wealthy Aga Khan, Indian potentate and owner of fast rare horses.

A few days later an explanation which added still further basis to reports of a diamond slump was offered by three millionaire officials of the powerful diamond syndicate which controls almost the entire world's output of the gems—Sir Solomon Joel, Sir Ernest Oppenheimer, and Sir Abe Bailey.

"Diamonds," said Sir Solomon, arriving in Cape Town to demand government restriction of production—"diamonds will become as common as artificial pearls if the present unrestricted output from independent alluvial diggings continues. Why, the alluvial diggers are now actually selling more diamonds than the great producers! If this continues, a collapse of the industry which provides the South African government with

three million pounds in taxes annually is sure to come.

That was the last straw. In the United States, where we use seventy percent of the world's diamond output, the effect was instantaneous. In New York City the Christmas diamond trade dropped off two thirds. The slump spread alarm among jewelers. They joined in issuing a reassuring statement.

"The price of diamonds," they said, "will continue upward as it has for thirty years. The interview quoted from South Africa was inspired for political purposes. The London Diamond Trust has itself bought up most of the independently mined diamonds, and will undoubtedly continue to keep prices up."

Apparently the jewelers were right. At this writing the price of diamonds has remained firm. The situation, however, has raised the interesting question:

"Will the diamond ever cease to be a thing of rare value?"

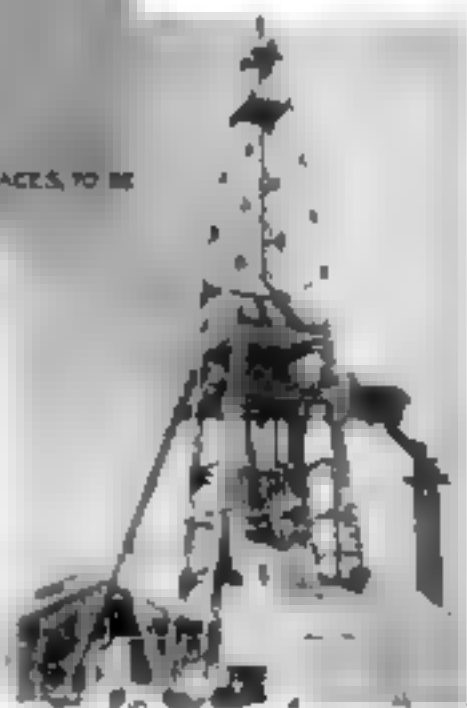
Probably. But there have been other diamond rushes. Four thousand square miles of South African territory contain precious stones. Continually prospectors are wandering over these lands, hunting diamonds. Occasionally they strike it rich, and the field is thrown open to claims.

Alluvial diggers continually are adding more diamonds to the output of the great mines such as the Premier, De Beers, Kimberley, Westerton, Bultfontein and Dutoitspan. Today the production of alluvial gems, valued three times more highly than mine stones, is virtually equal to mine production. Yet in spite of all this, the financial rulers of the gem market still are able to hold the prices up. Of the world's yearly con-

sumption of diamonds, which now is close to \$400,000,000, the syndicate is said to control nearly \$30,000,000.

But entirely aside from artificial price control, the diamond possesses in itself a unique value among gems, a place in the sun from which it probably never can be dislodged. Born in the white heat of molten furnaces beneath the earth's crust, made of stuff found in every living thing, this crystal of pure carbon continues to flash its colorful fire to allure men and women. Its beauty is enduring.

IN ADDITION, it is extremely useful. Because it is the hardest of all known minerals, it serves men in many ways, such as in drilling rocks and metals, grinding, polishing, and in supplying dies for drawing wire. It is virtually indestructible. Moreover, it is possibly the only medium of barter and exchange acceptable at face value in every country in the world.



Shafthead of the De Beers diamond mine, one of the richest in the Kimberley district of South Africa.

Some of the world's most beautiful diamonds have amazing records. Envy of their value and beauty has brought tragedy and misfortune to their owners. And superstitious folk have built around some of them, without the slightest scientific foundation, legends that are steeped in ancient mystery and red with horror. For stark tragedy the evil reputation attributed to the famous Blue Hope diamond has no equal. It is said that from the time in the seventeenth century that this forty-four-carat jewel was plucked from the eye of an idol in India to its sale several years ago to Edward E. McLean, Washington publisher, for \$180,000, its ownership caused more than a score of deaths.

FORTUNATELY, however, not all famous diamonds are associated with ill luck and tragedy.

There are many priceless diamonds, for example, the wonderful Koh-i-noor, also

the earth to unknown depths. These vast craters are filled with so-called "blue ground," a bluish rock believed once to have been flaming lava. In this rock are imbedded the diamonds.

The Premier mine, for example, is worked within an immense oval-shaped crater, 2900 feet in diameter one way and 1500 feet the other. Thus far miners have penetrated the blue ground to a depth of more than 500 feet, while the average depth of the mine is 525 feet. Operations are carried on in a series of levels at the bottom of the crater, from where the bluish rock is carried by incline haulage ways to a washing station at the surface.

Brought up in great lumps, the rock first is pulverized. After many siftings and washings, the work of extracting and sorting the diamonds begins. This, also, is now done by remarkable machines, covered with a special grease to which the diamonds alone of all the minerals hidden in the blue ground, adhere.

Besides the mines, there are the alluvial deposits of the kind that drew the latest rush of jewel hunters, already described. In these deposits the diamonds lie mixed with sand or gravel on or near the surface of the earth, and are

obtained by washing or "panning," much in the same simple way that placer miners pan for gold.

Most dramatic was the first discovery of the African diamond deposits.

One day in 1867, it is related, a wandering trader by the name of John O'Reilly reached the junction of two rivers and stopped at the house of a farmer named Schalk Van Neikirk. There he saw children playing with bright pebbles they had found along one of the streams. Believing the pebbles might be of some value, O'Reilly carried one of them to Cape Town, where an expert pronounced it a twenty-two-and-one-half-carat diamond. O'Reilly sold it for \$3,000.

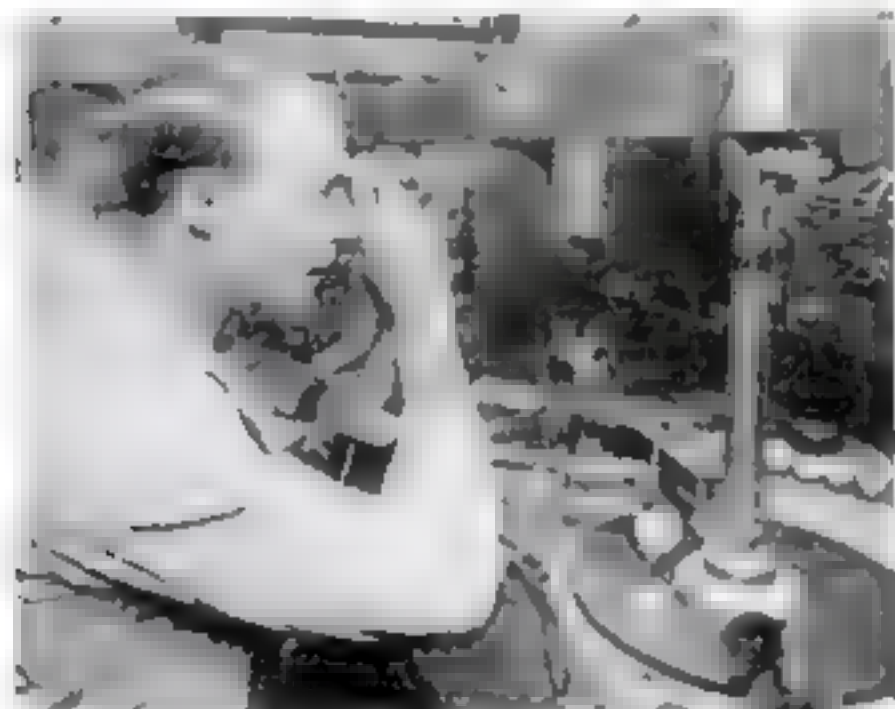
Van Neikirk, when he heard of the sale, remembered having seen an immense stone, similar in appearance, in the hands of a Kaffir witch doctor. Hunting up the scrooer, he drove a bargain and won possession. Another version says that Van Neikirk plucked the big "pebble" out of the mud wall of a neighbor's house. At any rate, it proved to be an eighty-five-carat diamond, now known as the Star of South Africa. Within two years after the finding of that stone, which brought \$50,000, the first South African diamond rush was in full swing.

AGAIN it was a peddler and contortionist from the streets of London, Barney Barnato, who, drifting to the new diamond fields in the '70s, amassed a great fortune and laid the foundations for the powerful syndicate, which has had much to say ever since about the prices the rest of us pay for our diamonds.

There are many varieties and grades of diamonds, and many factors, besides size, determine their value. Much depends upon their color or tint. Rarest of all are the red diamonds. One of these was discovered only a few months ago in alluvial diggings in the Kimberley district. It resembles a ruby of great size, and weighs six carats.

Next in order of rarity come the snow-white and blue diamonds, then the yellow, brown, and gray. These various hues are imparted by metallic impurities within the crystal.

The worth of a diamond depends largely, too, on the cutting of the stone and the shaping of its many facets, or faces, which help to give it sparkling brilliancy.



An expert diamond cutter at work—an exacting task in which one small error may ruin a costly gem, for it is his regular arrangement of tiny cut surfaces that gives the stones their radiance.

of Indian origin, which in 1850 was presented by the British East India Company to Queen Victoria. This famous stone, after its first cutting, weighed 279 carats, and after its second cutting, 106 carats. Then there are the Nizam of Hyderabad, 278 carats, the Regent, or Pitt, 137 carats; the Duke of Tuscany, 135 carats, Excelsior, 860 carats, the yellow Tiffany diamond, 125 carats, and many others.

BUT greatest of all was the monster Cullinan stone which, when discovered in 1905 at the Premier mine in the Transvaal, weighed no less than 3,106½ carats, or 137 pounds! And this was only a fragment, probably less than half, of a complete carbon crystal. Largest in the world, clear white and lustrous, yet full of fire, it was presented by the Transvaal government to King Edward VII as a birthday gift. Later it was cut into a number of finished gems.

In the famous South African fields, which supply the world with most of its diamonds, the stones are obtained in two different ways. First, there are the great mines, dug into strange volcanic vents, called "pipes," which reach down into

Piles of gems tempt flicking. Native miners are searched from hair to toes when leaving the mine.



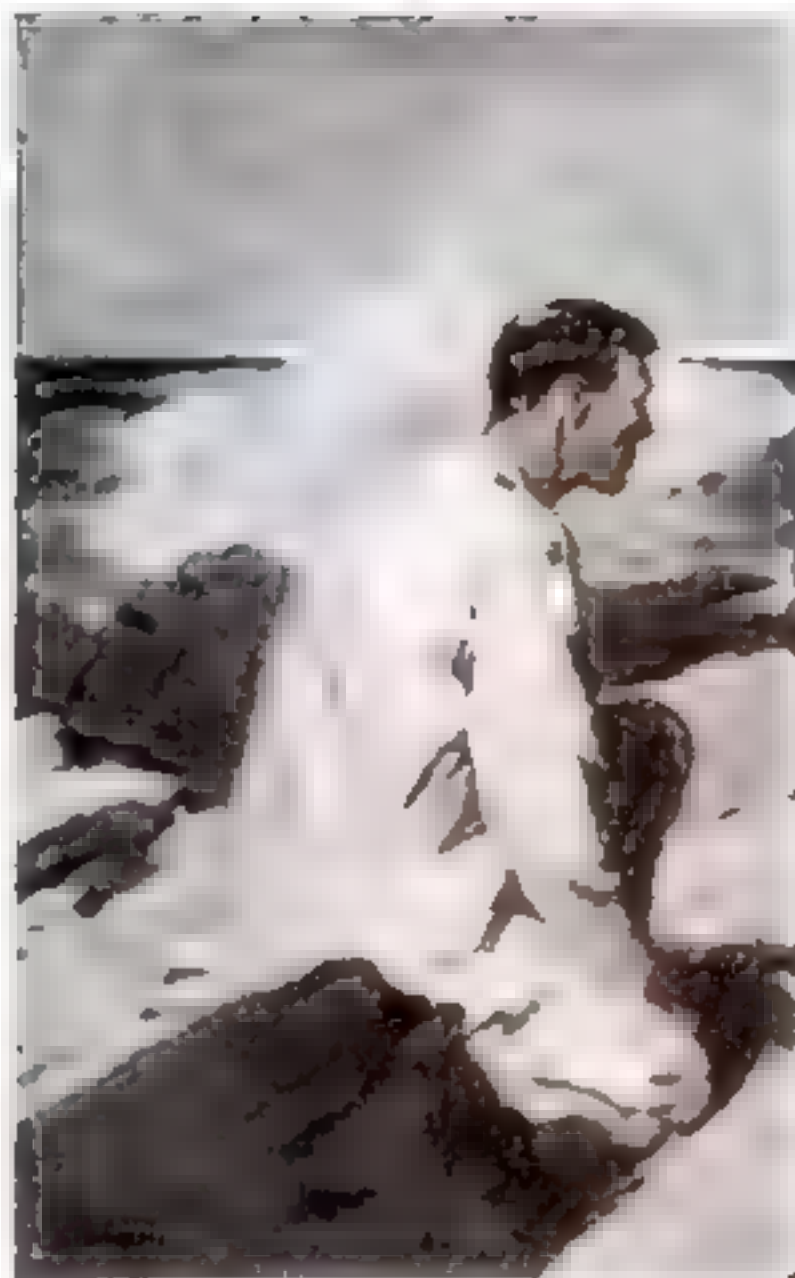
Extracting diamonds by hand from the blue ground, which has previously been crushed and washed. In many mines automatic extracting and sorting machines are now being used.

Beginning Bare Hands

*A Thrilling Novel of Brain
and Brawn at Grips with a
Wilderness of the Northland*

By Hawthorne Daniel

Illustrated by J. CLINTON SHEPHERD



KISKA JOE was wondering whether he should murder his four prisoners or not. The half breed was undecided, although the morality of such a course did not occur to him at all. He could consider the grisly question with as few qualms of conscience as troubled him while engaged in his usual occupation of seal poaching.

Consequently, the four yachtmen were safe for the moment locked in the cabin of their own yawl—and Kiska Joe was in the cockpit guarding the prisoners, with three Aleuts from his crew, and wishing heartily that his captives had never come ashore on that uninhabited and desolate island in the Aleutian Archipelago. However, wishing could do him no good, as the half breed knew perfectly well. He must decide what to do with his captives.

These troublesome white men should never have come so close as to make their capture necessary, he thought. But with some thousands of valuable skins aboard, and with the last of the cargo stowed, a shift of the wind had swung his heavily laden schooner onto a ledge of rock and he, carelessly he admitted, had called all hands to get her off. Thus it was that the yacht had slipped unseen up to the other side of the rocky Bulder Island and thus it was that the yachtmen had gone ashore, with the intention merely of taking motion pictures of the seal rookery, and had wandered down to Kiska Joe's schooner to ask if they might help get her off.

TO CAPTURE them had been simple enough. The newcomers had not been armed, and furthermore had thought as little of being captured as they might have thought of flying to the moon. But with half an eye they could see, from the scores of skinned carcasses that lay about, that the men they had come upon were poachers. For two hours now the four had been locked below in the yawl. Should they be allowed to go, Kiska Joe knew perfectly well that the Coast Guard shortly would be in possession of the evidence needed to end his poaching days forever. Obviously, then, he could not permit them to go. But what to do with them was another problem.

Kiska Joe knew little of white men. How important his captives were he had no means of knowing, but he strongly sus-

pected that they were prominent enough to call for an active search if they should disappear, and anything more than a half-hearted search might readily point to him as the cause of their disappearance. Therefore he had refrained from shooting them at once, but still he had not put from his mind all thought that that solution might be the best one. While the poacher pondered the graceful little vessel lay at anchor near Kiska Joe's schooner, which had been hauled off the bottom. And his captives fully realized their predicament, for he had explained it to them in terms that were clear and forceful, for all his broken English and profanity.

BELOW, the prisoners' conversation had been limited to grunts of disgust. They had planned the cruise as a vacation from their Seattle offices, and had sailed from Puget Sound four weeks before. That is, with the exception of Kelly, who was a hired deckhand, they had Parker and Thornton, who were partners in the engineering firm of Parker and Thornton, had accepted the invitation of Williams, the owner of the yacht, a young naval architect only recently out of college. But their pleasure cruise had suddenly precipitated them into a hornet's nest of trouble.

"Do y' think they'll kill us?" asked Kelly at last with the directness of a sailor of twenty years' experience at sea.

Thornton grunted and turned about upon his transom seat. For a moment no one spoke.

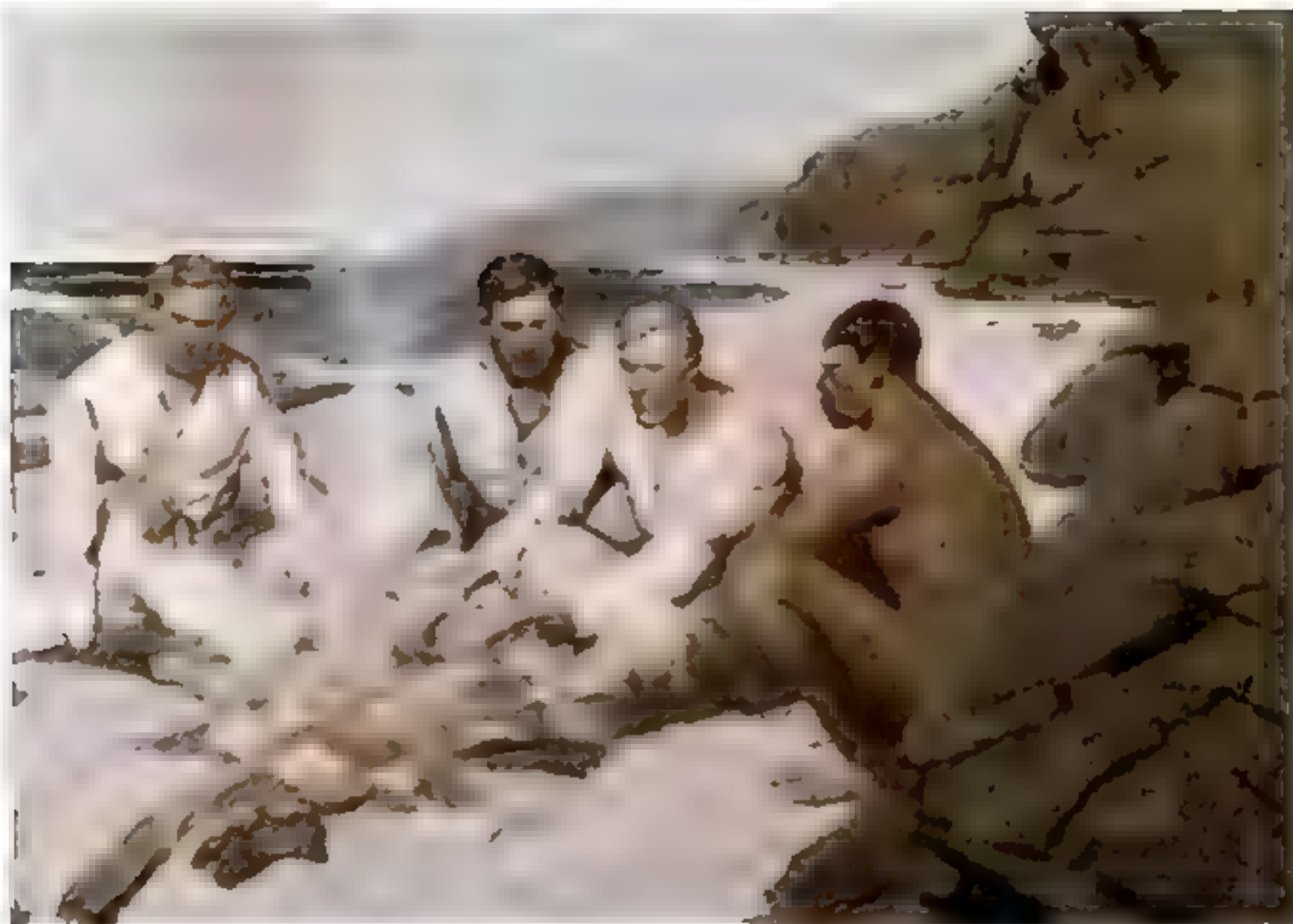
"Devil of a note," grumbled Williams, pulling his feet up beneath him as he sat on his bunk, and looking at his finger nails.

They heard their captors moving about on deck, but could make nothing out of their activity.

"They don't realize what they're doing," announced Parker, nervously puffing a cigarette and flicking away the non-existent ash with his long, slender finger. "Really," he pushed his free hand through his thin, sandy hair, "they should be sent to the penitentiary. They will be, too."

"If they're caught," added Thornton solemnly.

"If they're caught?" repeated Parker, sharply. "They'll be caught, all right. The Coast Guard knows them. If we don't



Cast up on the rock-strewn shore of the desolate island, the half-naked group of shipwrecked men huddled about the fire which Thornton had made without matches. To all save the Aleut, the place was strange and forbidding. For them the world seemed to center in the leaping flames.

come back, won't they suspect what has happened to us?"

"What good will that do?" asked Thornton. "It won't help us, and they can't convict these fellows on suspicion."

THORNTON'S pessimistic thought surprised Parker into silence, which was not customary for him. Rarely was he silenced in any such manner. Particularly was he prone to consider himself beyond the reach of any of Thornton's ideas. For fifteen years they had been friends—close friends, as men who are as opposite as fire and water sometimes find it possible to be. But somehow, at home and in business, Parker had always seemed to dominate. Perhaps that was because their profession was one in which theoretical and highly technical matters were forever up for solution. Parker was a theorist, and an exceedingly able one. Thornton, on the other hand, was a practical person, who saw solutions to practical problems with a clear eye and an active brain. Consequently, although they had roomed together through four years of college, where Thornton had won his letter for football and Parker had won his little gold watch key for proficiency in his studies, and for eleven years since had been associated together in business, Parker had dominated, while Thornton, who was big and calm and easy-going, had naturally taken his place in the shadow of his more brilliant and more nervous associate and friend.

BUT somehow the present situation had changed matters. Their capture by Kuska Joe was not a theory; it was, instead, a thoroughly practical and most disagreeable reality. Therefore Parker was lost, and therefore, too, Thornton, even without realizing it himself, had become the more important of the two. In fact, he had become the leader of the whole group, for Kelly had been accustomed to obeying orders for too many years ever to be able now to give them, and Williams was eight years the junior of the two engineers. Parker, however, could not be satisfied with meek silence for more than a moment.

"But won't the Coast Guard at Kuska Island suspect what has happened," he demanded, "if we fail to return?"

Thornton shrugged his broad shoulders.

"They might suspect everything," he replied. "But how could they prove it?"

Kelly had been sitting for five minutes with his eyes on a very detailed picture of a girl in tights tattooed on his hairy forearm. But now he showed that he really had not been engaged in cogitating over the merits of that work of art at all.

"But didn't they do a slick job?" he asked, almost as if he were lost in admiration of Kuska Joe's ability as a kidnaper of grown men.

"Hugh!" grunted Williams. "The scoundrels took every gun we had aboard."

"And the ammunition, too," added Kelly.

ON DECK the four poachers were talking to each other in their native tongue.

"Can you make out what they are saying?" asked Parker fumbling through his pockets for another cigarette.

Williams muttered a negative, and sat listening to the sound of oars as a small boat approached from the schooner. It came alongside with a thump, and he frowned at the thought of the mark that carelessness had left in the glistening white of his yacht's side.

"Scoundrels!" he growled.

The companionway had been locked from the outside when Kuska Joe had forced them below. Now it opened. The slide was shoved heavily back, and Kuska Joe himself descended. He was short and heavy set, and his swarthy face had more of the Aleut in it than of the white man. His beard was thin, and his mustache curved down beside his mouth. It was only in his eyes that any sign appeared of more than average keenness. But signs of weakness were there as well, and signs of a one-sided mind. He had successfully evaded the Coast Guard for a dozen years—had pitted himself against the watchfulness and ability of those capable men. Yet in other matters he was a child. Particularly was he a child in his superstitions, for he was the son of a renegade sailor who had deserted from a whaling ship, and then had deserted the Aleut woman he had lived with for a year or so. He had been reared in a distant Aleut community where superstitions and weird beliefs had pene-

trated well into that portion of his mind that was white, as well as into the rest that was essentially Aleut. As so often happens, he had inherited the weaknesses of both races from which he had sprung, and, to offset that, possessed only the keenness which, somehow, had been a part of the scapegrace father who had moved on to parts unknown forty years before.

HE LOOKED over the group in the cabin, and stood for a moment without speaking. His face was heavy and decidedly unpleasant, and his mustache wriggled when he spoke.

"You make me lot of trouble," he said at last.

No one replied.

"You stay below," he went on after a pause. "My schooner sho off the bottom again. I leave three men here. They stay on deck, and sail the boat. But no fool business. You know what I mean? No foolishness. I tell my men to shoot. Oomak is good shot. He never miss. We sail right away."

"Sail?" queried Thornton. "Where to?"

"None of your business," replied Kiska Joe. He climbed on deck, closed the companionway, and in a moment they saw him in a small boat as he rowed toward the schooner that lay a little way off, with her mainsail already set. They heard their own anchor aboard, and felt the gentle motion of the yacht as she headed away from Buldir Island. The schooner followed, and with a lively breeze they went speeding away to the west.

ALL the rest of the day they sailed until they were out of sight of land. Not far away the schooner slid along before a freshening breeze. Once Thornton tried to speak with Oomak, whom Kiska Joe had placed in charge. At first the Aleut did not reply, but finally he left the wheel to another man, and coming to the closed companionway shouted down to them in return.

"Shut up!" he bawled. "Kiska Joe say not talk. I not talk. Shut up!"

No, perforce, Thornton gave up, and Williams sat glowering on the transom seat, muttering to himself.

Conversation was spasmodic, and seemed to revolve mostly about two questions.

"What do you suppose they'll do with us?" was the insistent demand of Williams.

"Where d'y' reckon we're bound?" queried Kelly each time he looked out one of the ports.

"I don't know where we're bound or what they'll do with us," announced Parker, "but it's certain that their leader, whatever his name is, was merely ranting when he threatened us with death. He wouldn't dare do half the things he suggested."

"H'm," offered Thornton. "You weren't along when I talked with the Coast Guard skipper the other day, or you wouldn't be so sure. He told me about this fellow and he's a rough customer."

"NONSENSE," objected Parker. "The high seas were cleared of pirates long ago. He merely wishes to frighten us to prevent us from reporting him to the Coast Guard. Murder—pooh!"

"Have it your own way," replied Thornton. "But I'm going to watch my step. Kiska Joe has a bad reputation, and I'm inclined to believe he'll live up to it. Murder is something that won't faze him for a minute."

"What did the Coast Guard tell you about him?" asked Williams.

"Nothing much," returned Thornton, "except that they've

been on his trail for years and can't get a thing on him. He's lived on various islands around here all his life, and has been a poacher ever since he managed to buy his schooner a dozen years or so ago. Twice Coast Guardsmen who have gone out after him have disappeared, and once they found a man who had been on his trail dead with a bullet through his heart. They know he's a poacher, and they are morally certain he murdered those three men. But he always had alibis that couldn't be touched, and so he's free. Oh, he's rough, all right."

"Is that all?" asked Williams.

"It's about all I know," went on Thornton. "He had a wife and a child, but something happened to both of them. Nobody knows just what. There was some Aleut story about her having killed the child, and then she disappeared. But that probably was just native talk. They have some belief

that if a woman kills her own child bad luck will come to the whole village. So maybe they killed her. The officer who told me didn't know anything much about it. It happened before he came up here. But the Coast Guard tries to keep an eye on him all the time, and can't seem to manage it. Of course, Kiska Joe is an important person among the Aleuts, and they won't give him away."

"WELL, do we just have to sit and wait until he decides whether he'll kill us or not?" asked Williams, angrily.

Thornton shrugged and went into the galley to get himself something to eat. The others followed him one by one. They tried to figure out how they might surprise the three men in the cockpit, but no plan seemed promising. Finally night came down, when the yacht and the schooner still plowed through the white-capped seas.

"I'm going to see if I can't do something," announced Williams at last. "I don't like being cooped up here like convicts."

"What can you do?" asked Thornton.

"I don't know, but we can look through the forward hatch. They haven't locked that."

"Then I'm with you," agreed Thornton. "But be careful."

They went through the galley into the forecabin, and Williams silently started up the ladder leading to the deck. The hatch was closed, but was

not locked, and when they reached it he pushed up on it. It stuck a little, and he pushed harder. It opened with a loud squeak, and he stood for a moment holding it before attempting to climb out on deck. A gun barked sharply from the cockpit astern, and a bullet clipped a piece of oak from the corner of the hatch cover. Williams winced and dropped the cover into place.

"THAT'S that," he announced. "I guess they mean what they say."

The two went back into the cabin, and for an hour the group sat disconsolately, wondering what sort of a plan would succeed. Tiring, after a time, of doing nothing, Parker undressed, pulled on his pajamas, and climbed into his bunk. Presently the others did likewise—all save Kelly who, boasting no pajamas, slept in his woolen underclothes.

Outside, a heavy fog descended. The wind gradually died away. Sails slatted and banged, and only the undulations of the sea gave the yawl any movement.

Toward morning Oomak, at the wheel, sat looking at the lighted compass card while his companions slept in the cockpit. The schooner had disappeared in the fog, but Oomak was not worried. Being lost meant merely a few days of wandering about before he could find land somewhere. Below, his prisoners were silent and asleep, and save for the occasional rattle of a block, or the hum of a swell beneath the little ship, there was nothing to attract his attention.

Kiska
Joe



The hull here was
jacked, and here he
should murder his
four prisoners

For an hour he sat listlessly watching the compass, until the hypnotic effect of the light, and the slow movement of the card, cast a sort of spell over him. There was nothing he could do with the wheel now, for the yacht was merely drifting. A swell slid up from astern. Oonak, if he had been fully conscious, would have felt that it was higher than those which had been sliding past so regularly. But the compass card held him, and another swell slid by. It was higher still, but the Aleut was lost, and it too slid past. Then suddenly a sound came to his ears that made him leap to his feet and spin the wheel with all his might. A heavy sea seemed to come from almost under the bows. But he was too late. The swell passed and the yawl settled down. She struck with a crash; she shook and careened. Timbers cracked and groaned and the sea fell away, leaving the yacht temporarily motionless, pinned on a sharp black rock

BELOW, the men in their bunks were jarred into instant wakefulness. They opened their eyes to an appalling sight. In the dim light of early morning they saw a sharp section of the black rock thrust its way into the cabin through the bottom. Only for an instant was it visible. With a rush the water was swirling about their bunks. They leaped out and heard the Aleuts shouting on deck, heard the small boat go over the side. Then, with one thought, they dashed forward through the flooded galley into the fore-cabin, and one after another climbed the ladder to the deck. Parker thrust his head through the hatch just in time to see the small boat leave. As it shot away from the yawl, he saw that two of the Aleuts were in it, but that the third was entangled in a line.

Another sea swept under the yacht and lifted her up, only to drop her back again upon the jag of rock. The others scrambled to the deck. The Aleut untangled himself from the line and leaned shouting over the rail. But his companions paid no attention. Bending to the ears, they disappeared into the fog, headed in the direction from which the yawl had come. Another sea lifted the yacht and as Williams shouted that he was going aft for life preservers, the little vessel ground again against the rock. The sea foamed about her and flung her from the pinnacle. With a stream of bubbles she slid from the rock. For a moment her stern remained pointing upward through the fog, her jigger and her half-submerged mastsail showing ghostly white in the half light of the foggy morning. The men on deck were thrown into the sea, to struggle away from the twisted ropes that floated about. Then, silently, the yacht settled from sight, leaving the swimmers alone in the icy waves, surrounded and almost hidden from one another by the slowly eddying mist.

THE fog pressed down upon the struggling men. They could see no land, but wave after wave swept them toward the faint sound of breakers on a beach. They swam rapidly, fighting the chill, and could hear the sound growing louder. But one by one they became separated. Thornton found himself alone. The gray of morning had come, but in the enveloping blanket he could see nothing save the water immediately before him. He shouted and thought he heard an answering shout, but could

Next Month!

TISHY

A Gripping Short Story of an
Unusual Man Who Rose
to a Strange Emergency

By CAPTAIN DINGLE

Writer of Fascinating Sea Tales

not be sure. Chilled to his very marrow and worn with his efforts, he fought on. He knew that he was approaching the beach, for now he could feel the undertow, and he lunged weakly against it. Just when his lungs seemed ready to burst he felt himself thrown heavily on the sand. His breath was pounded from him, and he gasped for air as he lay almost helpless in the wash of the retreating wave. He staggered to his feet, but another sea covered him, whirling him about in a maelstrom of foam. Again the wave receded and again he staggered forward. This time he kept his feet, and when the next wave reached out for him it hurled him only to the waist. Another desperate effort and he fell limply upon the sand beyond the reach of the surf. He thought of his friends battling the sea, and made an effort to get to his feet to aid them, but his head whirled, bright

lights seemed to fill the world, and he fell again, exhausted and unconscious.

How long he lay there he never knew, but ultimately he awoke with a shiver, and lay for a moment with eyes closed. He shivered again, and sat up wondering where he was. Slowly he recalled what had happened. His friends came to his mind, and he rose unsteadily. The fog had lifted, and the sun shone clearly through the faint haze that was left. He swung his arms, clapped his hands against his clammy pajamas, and staggered forward. He had gone a few steps when he almost stumbled upon the body of a man on the sand before him.

IT WAS Parker, lying as if dead. Instantly Thornton's strength surged back to him. He knelt over the body and began to work with it. For minutes he labored, and presently felt a movement. He redoubled his efforts, and Parker opened his eyes.

"How are you?" asked Thornton, huskily. Parker shivered.

"Cold," he whispered.

"Can you sit up?"

"Cold," whispered Parker again. Alive to the necessity for swift action, Thornton rubbed his arms and legs, rolled him, punched him, and presently was rewarded by an objection.

"Don't," muttered Parker, weakly. "What are you trying to do?"

"Stand up," ordered Thornton.

"I'm cold," replied Parker.

"Stand up," insisted Thornton, dragging the other to his feet. "Now stand there," he ordered roughly, "and swing your arms."

Parker stood unsteadily and obediently waved his arms.

"Harder," shouted Thornton.

"Nonsense," muttered Parker.

KEEP it up, I'm going to look for the others." And Thornton left the man slowly swinging his arms in the sunlight. He glanced back, and saw that the movement was a little more energetic. "He's all right," he muttered, and turned away.

Kelly, when Thornton found him fifty yards farther down the beach, was already sitting up and rubbing himself. Hardly a dozen yards away there was a naked Aleut. That the naked fellow was one of the three from the yawl, Thornton knew, but which one he could not tell. Two had gone away in the small boat, he remembered, and had rowed away from the beach.

"Hello," said Kelly, hollowly. "Thought you was drowned."

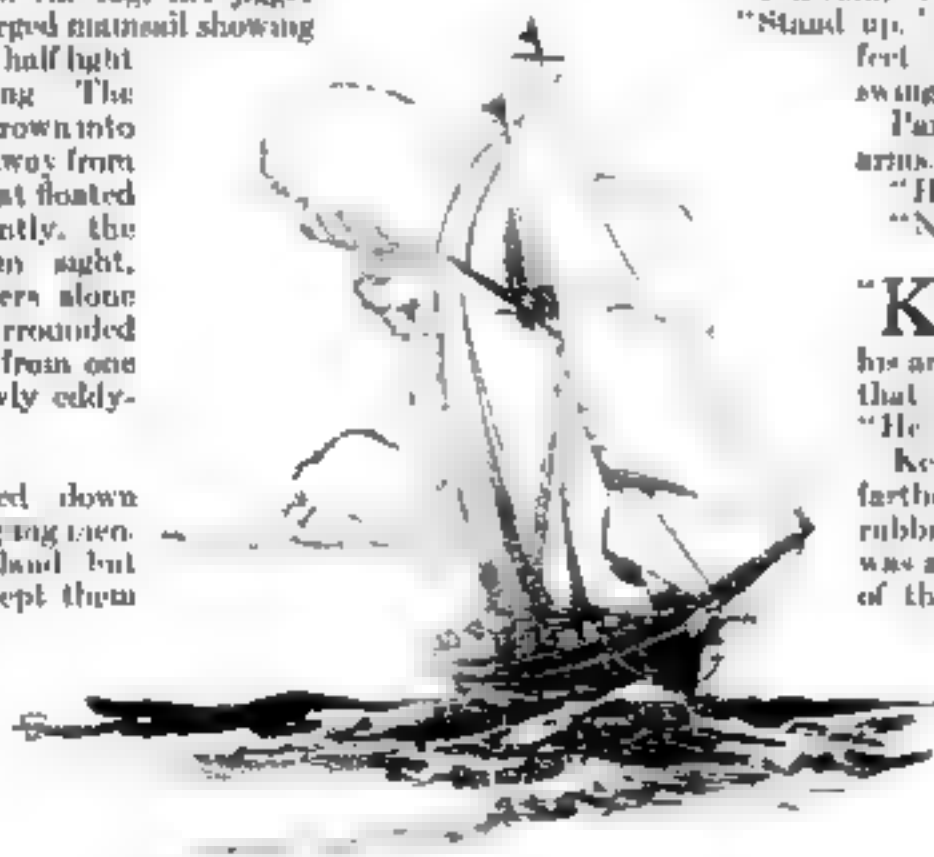
"Well, I'm not," replied Thornton. "And neither is Parker. Where are Williams and the other two Aleuts?"

"Haven't seen 'em," said Kelly, getting to his feet.

"Where are the others?" shouted Thornton at the naked Aleut, who was sitting on the sand and rubbing himself.

"No one," he grunted.

"I'm going to look for them, they" (continued on page 1-5)



For a dozen years the poacher's schooner had led the Coast Guard a lively chase, and had always evaded its pursuers.

Forty Thousand People

*With Gigantic New Skyscrapers
Towering Quarter of a Mile
High, Edison and Others Warn
Us Against Threatening Chaos*

WHEN Thomas A. Edison speaks, everybody listens.

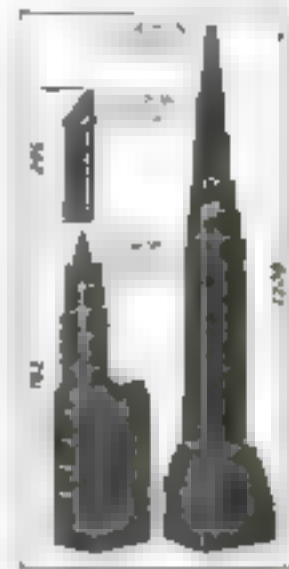
So it was that when the famous inventor a few weeks ago sounded the warning that "disaster must overtake us" unless overcrowded American cities call a halt to the building of mighty skyscrapers, he startled city dwellers and aroused a storm of controversy throughout the nation.

Almost simultaneously with Edison's warning came the amazing announcement that plans had been completed for a dizzy office spire of 110 stories, to rise from the heart of New York City and to tower far above the world's tallest buildings. This colossal structure, to be known as the Larkin Tower, will climb 1208 feet above the street level—410 feet above the sixty-story Woolworth Building.

From the rocks on which the feet of the new giant will rest to the tip of its flagpole the distance will be a quarter of a mile. Eight million bricks will go into the walls of its enormous body, while the steel required for its backbone and ribs will amount to 40,000 tons—enough to load a train twenty-two miles long. Including the value of the 50,000 square feet of land on which it will rest, this super-skyscraper will cost in the neighborhood of \$125,000,000.

LOOK at the architect's picture of the proposed Larkin Tower on this page and imagine yourself standing at a window on the hundredth floor and looking down upon specks of humanity on the street below. Then ask yourself if Edison is right. Are American cities in danger of strangling themselves to death with skyscrapers? Will pyramids like this, reaching ever higher to the clouds, end in rum and confusion? Or will they, as their designers assure us, bring increasing health, comfort, wealth and happiness?

Possibly time alone will give the answer. For the present, one fact remains undisputed. We are going to have more and higher skyscrapers. The design of the Larkin Tower typifies a distinct trend in typically American architecture. Even now in Detroit plans are made for the eighty-story Book Tower which, when completed, will out-top the present tallest building in the country by nearly



But the Flatiron Building on the Woolworth Building and their combined heights would be out-topped by the proposed Larkin Tower!

a hundred feet. At least a dozen other giants are in project in other parts of the United States. And designs and models of still other towered buildings have just been displayed by some of the nation's foremost architects in a recent skyscraper exhibit at the International Art Center, New York.

HOW high will they go? If one building can be made to climb nearly a quarter of a mile, what is the limit, if any beyond which a skyscraper ceases to be physically possible or economically practical?

The chief peril which Edison foresees is the traffic tie-up which he fears they will cause during rush hours of the day. He pictures as many people as there are in such communities as Newport,

R. L. Lexington, Ky., or San Jose, Calif., attempting, at approximately the same moment, to reach the entrances of a single building in the morning, or being poured into the streets, all at once, at the close of the day's work.

Nor is Edison alone in this fear. For example, Henry H. Curran, counsel to the City Club of New York and sponsor of new laws to limit the height of buildings, recently told a group of St. Louisans that the skyscraper already has given New York, Chicago and other large cities "structural indigestion." Similarly, Robert A. Pope, of the American Town Planning Association and Thomas Adams, director of regional planning in New York City, say that the size of skyscrapers must be limited to the traffic capacity of the streets.

FROM some of the nation's foremost skyscraper architects, including such men as Harvey Wiley Corbett, one of the designers of the Bush Terminal Building in New York, and Alfred C. Bosson, who directed the recent skyscraper exhibit, comes an answer. They contend that skyscrapers, far from being the cause of traffic congestion, really offer the most practical form of traffic relief; for they divert traffic from the city streets into the air, from the horizontal to the vertical.

"In other words," explains Mr. Bosson, "our skyscrapers really are additional streets, and their occupants travel three

The proposed Larkin Tower of New York City from an architect's drawing, showing how it will dwarf New York's present skyscrapers

within Four Walls!

By Robert E. Martin

or four blocks up and down in the air instead of traveling three or four blocks in a horizontal direction."

In addition, as Mr. Corbett points out, tall buildings, as now planned, are in themselves the centers of certain businesses and industries: one is a center of the garment trade, another an insurance center, and so on. Thus much of the business in any one industry can be transacted within the walls of one or two buildings.

ASIDE from the question of traffic congestion, however, other considerations may have much to do with determining the limits to which skyscrapers can go. Engineering problems, for instance, increase enormously with every story added to the height.

One of the chief of these is the problem of elevator service. To hoist cars to the top of a tall building requires tremendous lengths of steel cable, and there is a limit of length, beyond which such cables would snap of their own weight. To operate the sixty elevators planned for the Larkin Tower, fifty miles of cables will be needed, and some of the elevators will require cables a mile and a half long. But not one of the sixty will run to the top of the building. Two will ascend as high as the eighty-second floor, and from there shuttle cars will continue to the top floor.

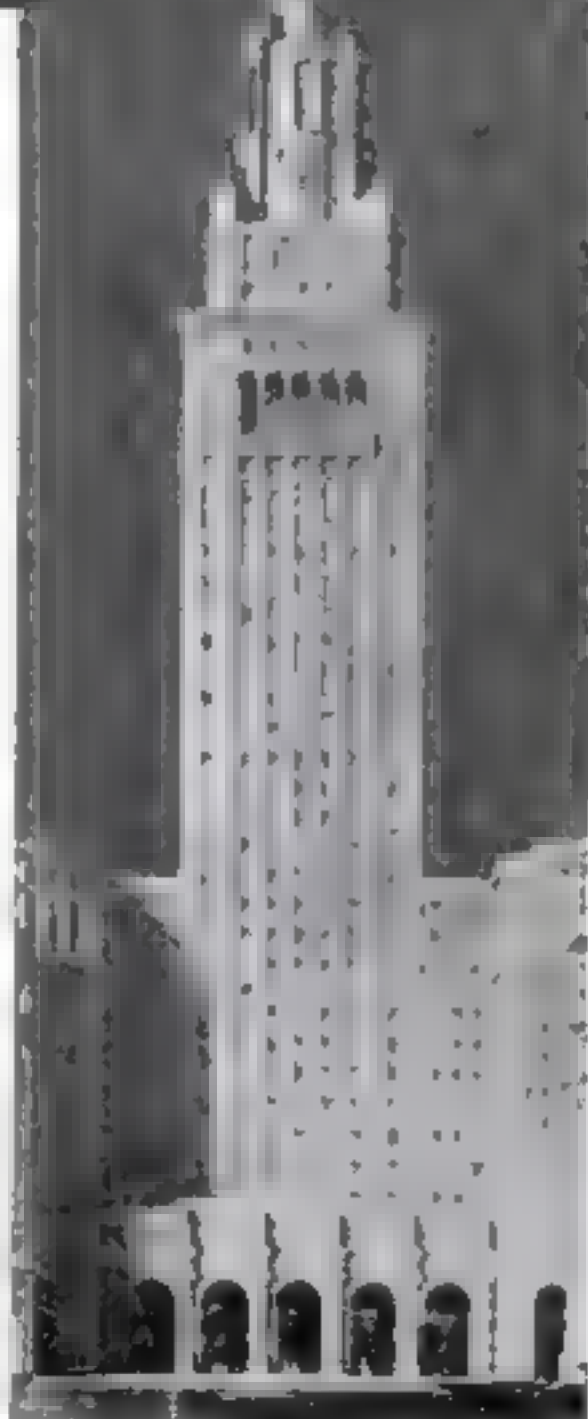
SUCH a relay or shuttle system of course, might conceivably be extended indefinitely in still taller buildings, but the resulting inconvenience might make the topmost floors of comparatively less rental value. However, faster and speed elevators for direct service eventually may solve the problem.

Still another height limitation is zoning laws such as those of New York which require the walls of tall buildings to be set back from the street at successive intervals to assure light and air for surrounding buildings. Obviously, these setbacks tend to taper a skyscraper toward a point beyond which it may not go.

But here again, there is no absolute limitation, for the possible height depends largely on the size of the plot on which the building stands. On a lot much larger than the site for the Larkin Tower,



A view of the Larkin Tower under construction, showing the steel framework.



The Union Terminal Tower, planned as Cleveland's greatest building, and above, Detroit's Bank Tower, taller than the Woolworth Building.



a far taller skyscraper might conceivably be erected within the law.

As for the physical possibility of erecting higher steel frameworks strong enough to support their own tremendous weight and to withstand wind pressure, engineers say that the height limit by no means has been reached. Materials and construction methods have progressed so far, they declare, that it will be possible to erect a building far higher than 1,200 feet.

FOR the Larkin Tower, three years of experiment have resulted in new methods of steel construction devised by John A. Larkin, the architect. He has perfected an unproved system for tying together the girders that form the supporting framework at the lower levels.

Nor do designers fear that great buildings offer extra (Continued on page 122)



Glenn Curtiss, the first man to fly an airplane in public. He has spent his life in pursuit of speed, holding at one time speed records for land, water and air. No man has done more to develop aviation. This photograph was taken recently at his Florida country home.

Glenn Curtiss

"I Liked Speed!" In Those Three Words the Great Pioneer Epitomizes His Romantic Career — The First of a Remarkable Series of Articles

sign or construction, engine or propeller. But long before that demonstration that the Secretary of the Smithsonian Institution had not been the futile visionary which the world had dubbed him, there had come, out of two widely separated bicycle repair shops, two completely convincing demonstrations that man could fly!

Only a bare twenty years ago; scarcely that. Yet so commonplace a matter is flying today that one must be middle-aged to recall the thrill which swept over the whole world in 1908, when people actually saw, first Curtiss, then Wilbur Wright, fly their planes. The dream of poets and philosophers from time immemorial had come true! The myths of the ancient races, the futile efforts of hundreds of years through which men had dreamed of flying, tried to fly, ridiculed the idea of flying, had crystallized into the hard-headed rule of the Patent Office that flying machines and perpetual motion machines must be demonstrated before a patent application would be considered.

Then suddenly happened Marston?

Only the credulous believed those first stories of a glorified Cypriote press; reporters held among the scandal-mongers at Kitty Hawk that they had seen a

machine go into the air, carrying a man. It remained for Glenn Curtiss to prove it to all the world on the Fourth of July, 1908, when he flew the "June Bug," a machine of his own design and construction, for all men to see.

From then on he took and held the leadership in the development of the airplane, and in flying. His was the first pilot's license issued by the Aero Club of America. He was the first to win the trophies and prizes offered in America and Europe for distance and for speed in the air. Every plane in use in the world today embodies the principle which he invented and developed and which alone made flying as we know it today possible, the principle of the aileron. He was the first to build and fly a plane equipped to rise from, and land on, the surface of the water. The flying boat was his invention.

Under his guidance and in his planes the air-men who rank highest in the service of the Army and Navy today learned to fly.

When the European war broke out it was to Curtiss that the Allies turned first to supply the needed planes, beyond their own resources, to enable them to meet the German army in the air. And after the war it was a Navy-Curtiss flying boat, under the guidance of one of Curtiss' pupils, which made the first flight across the

Atlantic ocean.

In short Glenn Curtiss made aviation practical.

He is still under fifty. His life story has never been told in print. The editor of POPULAR SCIENCE MONTHLY commissioned me to find him and persuade him to let his story be written. I found him in southern Florida, gratifying his craving for speed by building a new suburb of Miami—his third or fourth—in record time. On the grounds of the archery club at his newest Miami suburb, with a six-foot African hunting bow, he was the embodiment of speed in action.

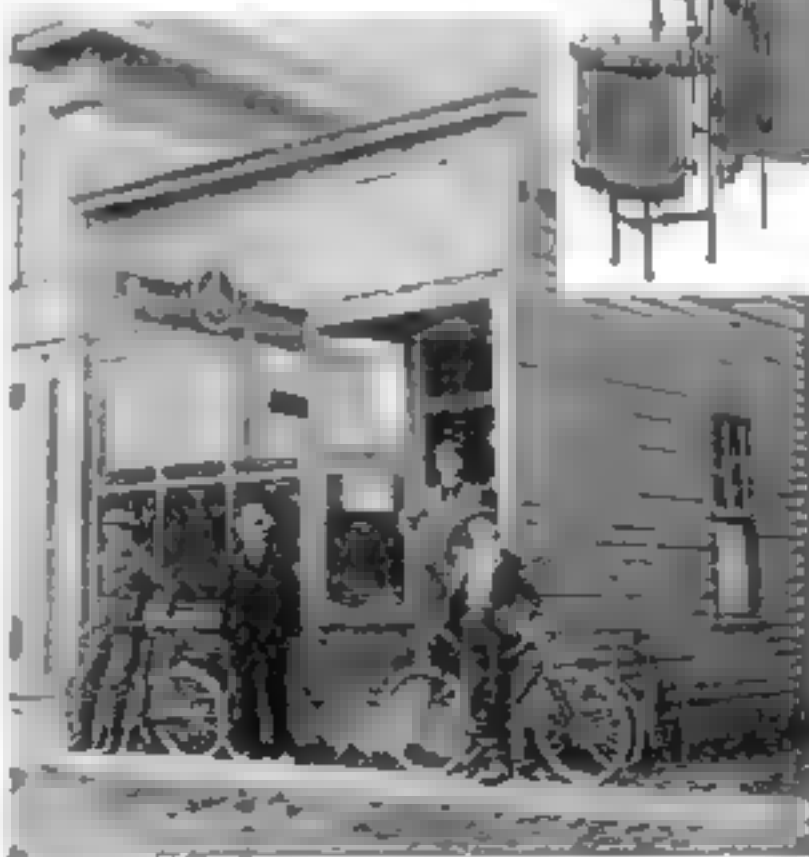
THIS is not a story of dreams come true. Glenn Curtiss, as a boy, never dreamed of flying! Yet flying, designing and

building airplanes, lifting flying from a mere scientific marvel to a practical, commercial means of transportation, was a natural evolution from the tastes and occupations of his boyhood and young manhood. Speed was his boyhood ambition, the desire to travel faster, do things more quickly than other boys could do them.

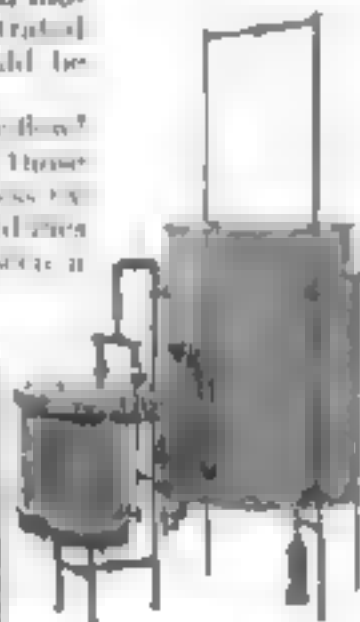
Three names stand at the very beginning of the history of aviation.

First in point of time is Samuel P. Langley, secretary of the Smithsonian Institution, who pointed the way in the development of heavier-than-air machines. Next come the Wright brothers of Dayton, Ohio, first actually to get into the air with a motor-propelled machine. Then, finally, Curtiss joins the honor roll as the first to make a preannounced public flight, first, too, to make it possible for everybody to fly.

An incredulous world laughed Professor Langley to an untimely grave when his great "aerodrome," snagged on the launching-way, dived into the Potomac river. Yet Glenn Curtiss told me that when he flew that machine, years later, it was unchanged in the slightest detail of de-



The little bicycle repair shop at Hammondsport, N. Y., in which the engine that led Glenn Curtiss into aviation was developed. Standing in the doorway is the young proprietor-inventor. Above, Curtiss' first invention—a double-chambered acetylene generator.



Air Pilot No. 1

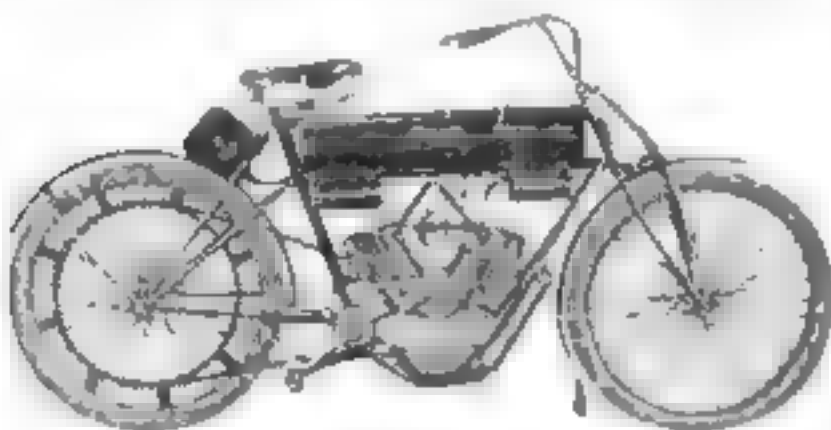
By
Frank Parker
Stockbridge

Long and lean—"rangy" is the word—he seemed the most unhurried of the whole team of archers, but he moved faster and shot his arrows farther and more accurately than any of them. No false motions. Everything counted. I did not have to ask questions to get some of the information I had come to seek. Here was a man who thinks before he acts, then acts precisely, without fumbling.

TYPICALLY American. As typical as the cartooned Uncle Sam—with his high forehead, light blue eyes, long, thin nose, only the chin whiskers and star-spangled plug hat lacking. Large, competent hands, the long fingers of the artist, the capable thumbs of the born mechanic.

How had it come about that he, of all the youth of both hemispheres who had essayed to fly twenty years ago, on the heels of the Wrights' demonstration that man could fly, had done more than all the rest of them to make flying easier, safer, more popular?

The Wright brothers were the first to fly, nobody conceded their priority more generously than Glenn Curtiss. But he was the first to devise and build airplanes that anybody could learn to fly, himself the first to fly farther, faster and higher than anyone else could go. "For the increase and diffusion of knowledge among men," reads the inscription on the pound of pure gold which the Smithsonian Institution gave him a dozen years ago and more, the Langley Medal for Aerodromics, awarded to him first of all Americans. That pretty nearly sums up the story of



Twin-cylinder type of Curtiss motorcycle: the young bicycle repair shop proprietor, at the turn of the century, was manufacturing the fastest motorcycles of his day. One of these engines furnished the motive power for the first successful flight of an airship.

his contribution to the science and art of flying. Others practiced flying in secret, he invited the whole world to see him fly; to fly with him, showed them how it was done, taught them how to do it.

His answer to my first question, added to what I had observed, almost told the whole story of how he became a flyer.

"My boyhood dream of the future?" he repeated. "Why I don't know that I had any. I always wanted to get things done, and do them faster than the other fellow. I hated to be beaten. I liked speed, and I liked to make things. I was always handy at fixing things."

That accounts for Glenn Curtiss. Take a Yankee boy, born with the Yankee gift for "fixing things," throw him on his own resources, fire him with a craving for speed and disgust at being beaten, and he is bound to make something which will either enable old things to be done faster and better, or which will do something which has never been done at all before. What he will make and what it will do, nobody can foretell.

Nobody could foretell, when Glenn Hammond Curtiss was born in the Methodist parsonage at Hammondsport, N. Y., on May 21, 1878, that before he was thirty men would be flying like birds. It happened that flying was "in the air" just at the time that his Yankee ingenuity was ripe to tackle it. Ten years later it might have been radio; ten years earlier, electric power. Glenn Curtiss found his means of gratifying his craving for speed and exercising his talent for "fixing things," first in motorcycles, then in dirigibles, then, by a natural sequence, in airplanes. And how well he

succeeded may be gathered from the fact that he made, and for years held, the world's record for the fastest mile on land and the fastest mile in the air, driving machines of his own design and construction in each instance while a boat of his design and engined with his motors made the fastest speed ever recorded on water up to that time.

HAMMONDSPORT, Steuben county, New York. A typical American small town, lying at the foot of Lake Keuka, the "forefinger" of New York's "finger lakes." Intensely hot in summer,

ripening the finest grapes grown this side of the Atlantic on its steep hillside; intensely cold in winter.

Fine for coasting, those steep hillside. "When Gene Banter, who used to work for my father, built a sled for another boy which was the fastest coaster on our hill," he told me, "I wasn't satisfied until I had got Gene to build one for me that would coast even faster. I guess that was about my earliest taste of anything like real speed."

LEFT fatherless at four, the boy had to learn whatever money his youthful tastes demanded, in a household where pennies had to be counted. Tying and pruning grapevines and picking the grapes at harvest time was one way. Another way was to make the things he wanted and couldn't buy, a pin-hole camera made from a cigar box for example. "Handy at fixing things." He grew tall and rangy, a runner, a skater. Dissatisfied with his unaided speed on ice, he built a sail, a stout bamboo fishpole for a mast. Now he could outspeed everything. Lake Keuka when the Arctic winds blow down from Canada!

He was twelve years old when his mother moved to Rochester, to put Glenn's younger sister in a school for the deaf. Glenn kept on at school, too, but helped out the family income by working after school and on Saturdays. Tinkering, "fixing things" in his spare time, he built a creditable telegraph set.

"There was good workmanship in that," he told me. "I was about fourteen, and a handy boy of fourteen ought to do and usually does a workmanlike job. That was about the time I finished school. I got as far as the grade schools could take me, and that is all the formal schooling I ever had. I got my high school entrance certificate, but never used it. I remember that I made one hundred in algebra in that examination, and ninety-nine in



Test flight of the queer, cubanless Army Dirigible No. 1, at Fort Myer, Va., 1905, with Curtiss, forward, at the engine and Capt. T. B. Baldwin, aft, steering. It rode "like a centering horse."

arithmetic, but in geography, grammar and spelling I had to take the examination three times to get the passing mark of seventy five."

Out on his own at fourteen. Out for a regular job. He found it first as a telegraph messenger, then at the Eastman Kodak works, stencilling the numbers which show through the red window in the camera's back, on the protective strips of paper. At \$3 a week!

NOW Glenn Curtiss' genius for "fixing things" brought its first tangible reward. After mastering the job and thinking it over, he went to the boss with a proposal to put the boys on piecework, at twenty-five cents a hundred strips. They were averaging 250 strips a day, which would make the piece rate yield them just about the equivalent of their \$3 wage. The proposal was accepted, and Glenn showed up at the shop the next day with a rack which would hold a hundred strips, a hinged arrangement to hold the stencil and enable it to be lifted and replaced rapidly, and a brush big enough to "wipe" the color across the whole stencil at one stroke instead of dabbing at each individual hole.

"Production jumped so rapidly that they kept cutting down the rate until we were getting only nine cents a hundred," he told me, chuckling at the recollection. "Even then we made good wages—for boys in those days. We got the production up to two thousand five hundred strips a day per boy, ten times the original output. That gave us more than they had been paying the men we had repaired. That was my first lesson in the value of mechanical ingenuity, and also in the superiority of piecework over wages when production at speed is sought."

MRS. CURTISS.

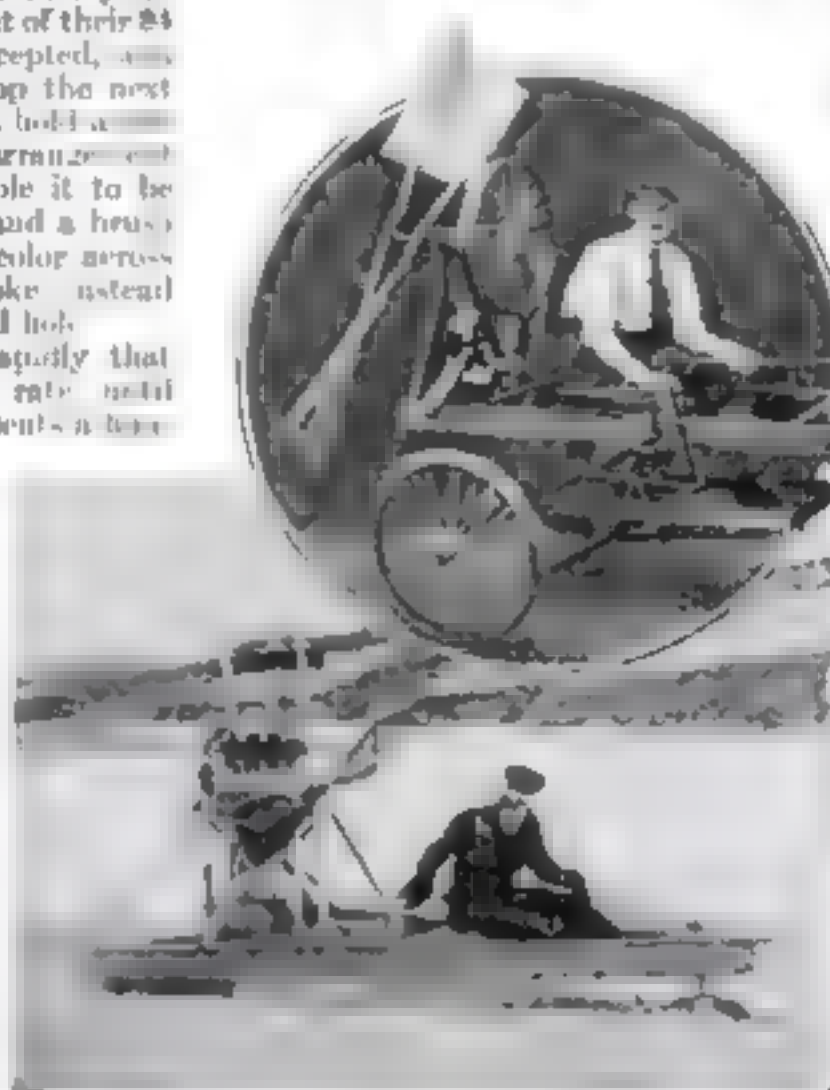
Glenn's mother, had found profitable work in free-hand crayon enlargement of photographs. Mechanical processes, air-brush work on bromide enlargements, enabled others to cut prices, so she decided to adopt the new method and acquired an enlarging camera.

"That brought a lens into the family," he said, "and it was inevitable that I should make a view camera to fit it. I made a pretty good one. I remember that I was rather proud of the workmanship. Then my mother married again and I went back to Hammondsport to live with my grandmother, and took the camera with me.

"I made money with that camera. I went around the country photographing things on the farms. The farmers usually thought pretty well of their horses and barns; their wives liked pictures of the house and the children. The first trip I would not try to sell anything, just got them to let me take the pictures. Then when I called again with the finished prints they usually bought them."

He earned a bicycle by this and other means, tinkering, "fixing things." Wir-

ing electric doorbells, for instance, electric lights had not yet come into Hammondsport in the middle nineties. The bicycle enabled him to extend the range of his photographic work, and to gratify his craving for speed. There was no vehicle of any sort, on land or water, in those days, that could go as fast as a bicycle, except a railroad train. One or two experimenters were trying to hitch gasoline engines or electric motors to carriages, but when they worked, which was not often, any good bicyclist could ride rings around them. Hammondsport and Glenn Curtiss had never even heard of the not yet quite born automobile. But Glenn Curtiss could push his "wheel," with those long legs of his, uphill, downhill or on the level, faster than any other



How Glenn Curtiss came to know more about air propellers than anyone else in the world. The "wind wagon" which he built on runners, to test out engines and propellers on Lake Keuka in winter above, the "horse scarer," for the same purpose on land

boy in Hammondsport. Soon his knowledge of bicycles and his handiness at "fixing things" got him a job in the bicycle repair shop owned by James Smellie. It was not long before he was running the shop. This was in 1897, when he was nineteen.

A rival bicycle dealer and repair man organized a five-mile road race over the rough highways of the Keuka valley. Smellie thought Glenn could win if he had a racing machine, and arranged with a bicycle factory, which promoted its wares by encouraging young racers, to sell the boy a racer at half price, on installments.

"I felt as if I were stealing it," Mr. Curtiss said, "when I got a hundred dollar bicycle for fifty dollars."

That race is still historic in Hammondsport. Glenn Curtiss won by half a mile! It was a sensational victory, and from then on for three years his yellow Stearns racer led the way in innumerable rural and small town bicycle meets and road races.

For the remarkable fact is that he won every race in which he started, until the last one.

"WE RACED for cash prizes in those days," he told me. "The distinction between amateur and professional was not drawn until later. There were always bicycle races on Decoration Day and Fourth of July and when the volunteer firemen held a field day. Sometimes it was a stretch of country road, sometimes the trotting track at the county fair grounds. I raced all over the southern tier of counties and got a good deal of cash that way. Then I went to a race meet at Syracuse, at the State Fair grounds, and was beaten. That was enough for me. I was through with bicycling and began to look for something faster. I didn't like to be beaten."

By this time, 1900, he had got ahead in the world sufficiently to open his own bicycle repair shop and sales agency. One day his old employer, Smellie, puffed up the hill on his bicycle.

"I'm tired of pushing this old wheel up here," he panted. "I'm going to give it up until I get something to push it."

That gave Glenn Curtiss a new idea to think about. Then, as now, he thought over things a good while before putting his ideas into action. But he had done several things in his bicycle shop which had given him a local reputation as an inventor as well as a skilled mechanic, and he had two or three young men working for him who were incapable of surprise whatever the freak job might be that they were told to do.

ONE of the Curtiss inventions was an acetylene gas generator which worked better than anything Hammondsport had seen. People in country towns had hardly begun then to dream of the time when every village and farm would be lighted by electricity. Acetylene seemed to be the ideal light for such places, easily generated by letting water drop on powdered calcium carbide, which was being produced cheaply at the new industrial center at Niagara Falls.

Called upon to repair an acetylene generator, Glenn Curtiss devised an improvement. The main objection to the ones in use was that they required a good deal of attention, and when the carbide was exhausted the lights went out until the machine was recharged. He made one with two magazines for the carbide, so arranged that when the contents of one were used up the other would come into action, giving continuous light while the first magazine was being recharged. First he lighted his own home and shop, later several business buildings in Hammondsport, by means of the generator of his own devising.

Such activities gave the bicycle shop something to do in the winter, when the bicycle business was dull.

"I used to resent being called an inventor," Mr. Curtiss told me in Florida. "An inventor, as people in country towns thought of him, (Continued on page 130)

The New Gifts of Science

Outstanding Achievements in Various Fields That Are Making Life Easier for All of Us

ONE of our readers has written to us asking us to select the most important recent achievement in science.

Rather a large order, that! We might answer by saying that the biggest thing science has done of late has been to sweep away barriers limiting human knowledge and achievement. For in the last few months the last unknown lands of the earth have been penetrated by explorers, limits of time and space have been annihilated, regions far beyond the visible heavens have been searched; unseen forces hidden within the smallest specks of matter have been brought forth to produce new marvels.

No single new accomplishment of science can be said to stand alone in importance. But the following undoubtedly must be considered outstanding contributions.

Exploration

VAST stretches of the Polar Sea, one of the few remaining regions of the earth unexplored by man, were seen for the first time when Lieut. Commander R. E. Byrd, U.S.N., reached the North Pole by airplane from Spitsbergen, and when Roald Amundsen, a few days later, crossed the Pole to Alaska in the airship *Norge*, covering 4700 miles in 71 hours.

Wildernesses in the heart of New Guinea in the South Seas, the only known land never before trod by white men, were penetrated recently by an American-Dutch party of explorers.

Icy shores of Greenland were visited by an expedition, headed by Dr. William H. Hobbs, of the University of Michigan, searching for the source of hurricanes that sweep down upon trans-Atlantic shipping.

Transportation

THE practicability of the latest airplanes and dirigible airships alike for long distance travel was proved in the Polar flights, in the 3540-mile voyage of Spanish Biers across the Atlantic from Spain to South America, and in the 20,000-mile journey of Sir Alan Cobham from England to Australia and back.

A record-breaking dash around the earth was made by two Americans, Linton Wells and Edward S. Evans, who completed the circuit in twenty-eight days. Airplanes, automobiles, railway trains, motor boats and ocean liners all had a part in the achievement.

The last year has seen the airplane firmly established as a vital factor in commercial transportation. In America alone, commercial aircraft flew 1,774,208 miles.

New faith, likewise, in the future of lighter-than-air ships is shown in the authorization by Congress of two dirigibles of 6,000,000 cubic feet capacity and in the completion of the new Army semi-rigid airship *RS-1*. Great Britain has begun construction of two 5,000,000-cubic-foot dirigibles, and Germany one of 5,500,000 cubic feet capacity for trans-Atlantic service. Airship mooring masts have been erected at Detroit, Mich., Scott Field, Ill., in Egypt and in India.

Communication

MARVELOUS inventions and discoveries in radio bring assurance that the next great step, vision by wireless, is not far off. The latest achievements in television apparatus are described on page 37 of this issue. Other recent advances in the same direction were improvements and refinements in radio transmission of pictures.

A long step in world wireless communication was the recent inauguration of directed "beam" transmission on a large scale in the British Empire. Equally important was the successful establishment of two-way radio communication between New York and London. As this is written arrangements have been completed whereby a person in New York can call up and chat with a friend in England!

Physics and Chemistry

BY DISCOVERING and harnessing mysterious forces of creation, the men of pure science in the laboratories have added appreciably to the world's wealth. Dr. W. D. Coolidge's cathode ray tube, the purplish rays of which trans-form almost every object they strike, and Dr. R. A. Millikan's verification of the existence of extremely penetrating cosmic rays, are outstanding recent wonders.

Artificial gasoline from liquefied coal fuels from sawdust, water, coal and molasses; sugar from wood, sawdust and roots—these are typical of new laboratory creations. In the rubber field, an important new process was developed for rubber-plating articles.

Helium was produced in solid form in recent experiments, hydrogen was transmuted into helium, and a new chemical element, illium, was discovered.

Engineering

COMPLETION of the great tube for vehicle traffic under the Hudson river between New York and New Jersey, the projection of tremendous skyscrapers

reaching far above any we have today; and plans for the world's greatest bridge across the Hudson are demonstrations that men with modern machinery can accomplish almost anything they set their minds to.

Methods have been perfected to replace the din of riveting by electric welding of steel beams in the construction of huge buildings.

Increasing demands for electric power have brought the installation of a monster 80,000 kilowatt turbine generator, largest in the world, for the Brooklyn Edison Company, while work on still larger ones was started for the Commonwealth Edison Company of Chicago and the United Electric Light and Power Company of New York.

A step toward superpower has been the vast project announced to harness the waters of the Tennessee river with 100 dams, including the Muscle Shoals dams, capable of generating 4,000,000 horsepower.

Medicine

INCREASED microscopic knowledge of bacteria, of their reproduction and their effects on the body, has brought progress toward human immunity from disease. Dr. Philip Hadley of the University of Michigan has carried on experiments indicating that a species of bacteria in many cases can be divided into two distinct types, existing side by side, one of which resists defensive cells of the blood, while the other is readily destroyed by them. Serum from an animal inoculated with the disease in question, he found, has power to change the virulent form into the nonvirulent form.

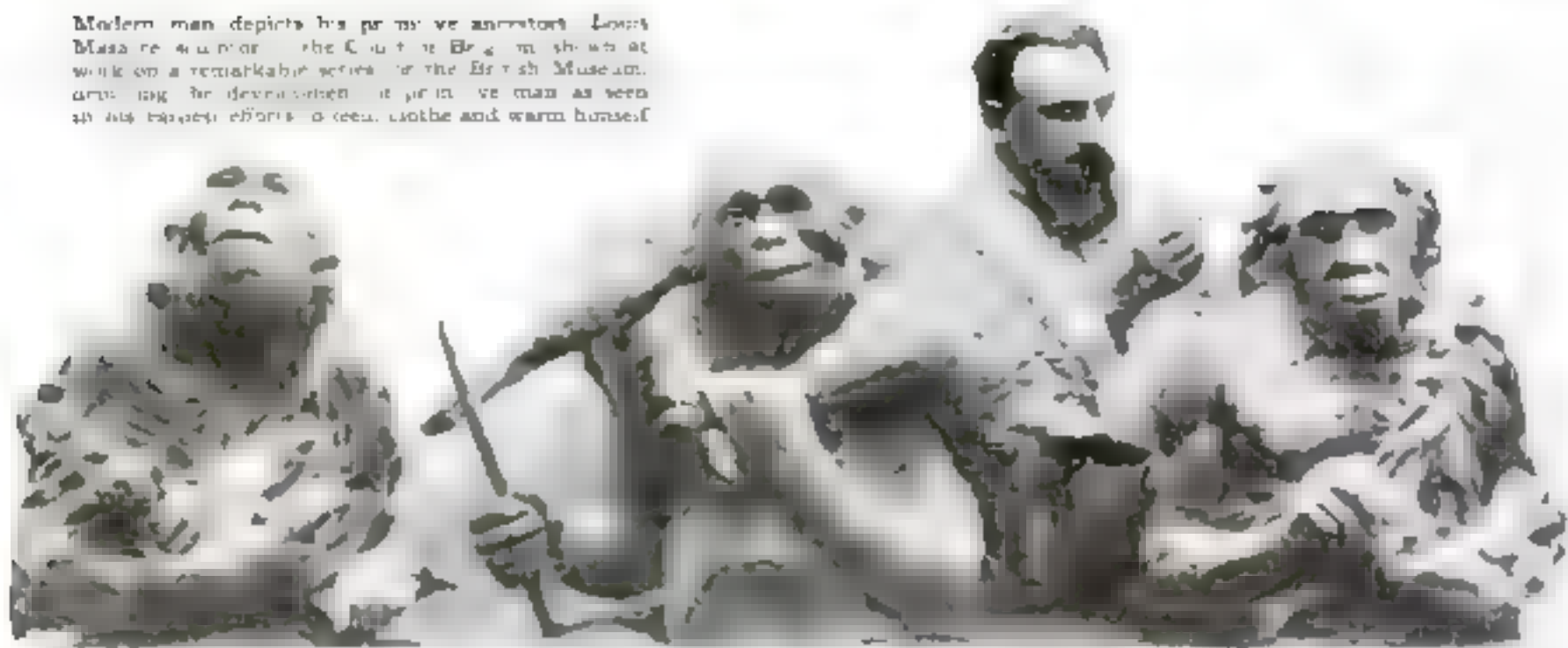
Partial immunity to measles through injections of serum from persons who have recovered from the disease has been claimed in a report to the League of Nations Health Committee. Moreover, Dr. F. B. Krambhaar of Philadelphia, recently announced the discovery that the spleen is an important source of the defensive blood cells which aid the body in resisting disease.

Astronomy

WITH the aid of powerful telescopes astronomers have been able to peer farther into the borderlands of space than ever before. Dr. Edwin Hubble of Mount Wilson Observatory has announced that the region of space within the limits of man's observation now is a sphere 140,000,000 light years in radius.

F. G. Pease, designer of the great Hooker 100-inch reflector telescope for Mount Wilson *(Continued on page 24)*

Modern man depicts his primitive ancestor. Louis Masson, curator of the Clouston Bequest, is at work on a remarkable series for the British Museum, depicting the development of primitive man as seen in his typical efforts to keep, clothe and warm himself.



Mainly About People

What Unusual Folk Are Doing



He has the first and last word on the weather reports. J. J. Murphy, of the farthest east of U. S. Weather Bureau stations at Eastport, Me. The instrument he is reading is an anemometer.



A licensed aviator at thirteen—Frank Rippling, Detroit school-boy who was granted a pilot's license recently in the National Aeronautic Association. He is shown being congratulated by Clyde Smuck, his flying instructor.



Strange masks the Indians wore—A. H. Fisher, naturalist, recently brought from Peru, South America, for the Museum of the American Indian, New York City, a rare collection of ancient Indian relics, including these ceremonial masks of bark.



America's most famous ship, "Old Ironsides," is pictured again in all her glory in this painting by Gordon Grant, noted artist, painted as part of a nation-wide campaign to restore the ship. Models of "Old Ironsides" are being made by many readers of *POPULAR SCIENCE MONTHLY*, following the construction articles published.



Serious business, this! In his own home workshop in Washington, D. C., Rush L. Holland (right), former Assistant Attorney General of the United States, finds time away from his law practice to indulge his hobby of cabinetmaking. William G. Wheeler (left), who is also an attorney, shows both the hobby and the shop.



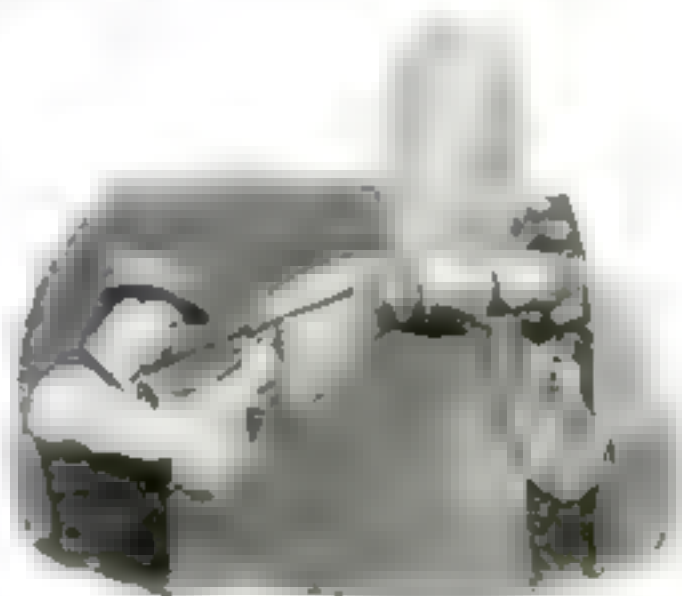
A violinist-artisan, George Link, of Abingdon, has been known as the bricklayer who makes fine violins. Starting as a bricklayer, he learned violin making without instruction, out of love for it. He repairs violins, too, and has worked on some of the finest instruments in the world.



She owns a foundry plant run entirely by women. Miss Annette Ashbetry, shown here watching one of the women at work in her plant at Braxton, England, was recently elected a member of the British Society of Engineers. This unique plant is "manned" entirely by women, who do all kinds of foundry work.



Founders and only living members of one of the most exclusive organizations in the world—the Polar Legion—consisting of leaders of expeditions which have reached the North or South Pole. Left to right, they are Capt. Roald Amundsen, Commander Richard E. Byrd, and Lincoln Ellsworth. Byrd reached the North Pole by plane last spring, Ellsworth and Amundsen by airship.



Motor boat owners know him. Bert O. Godfrey of Seattle, Wash., who solved a long-standing problem of motor boating when he invented the remarkable apparatus above for testing and correcting the pitch of a propeller.



Wrestling with alligators under water—but George Link, who then pitted his skill against the saurian's strength, emerged victorious only after the monster's teeth had been taped. The photo was taken through the glass tank.

- ❶ For healthful ventilation in your home—keep the temperature from sixty-five to sixty-seven degrees, with a fifty percent relative humidity.
- ❷ Open the windows at top and bottom. Avoid drafts. Drink fresh air while indoors, but don't take it straight. Mix it with air previously warmed.
- ❸ Sleep warm, but allow for a free flow of fresh air throughout the room through the night.
- ❹ Buy a thermometer and watch it all the time.



Do You Breathe *the* Right Air?

How a Hot, Stuffy House Destroys Your Health and Efficiency, and How to Ventilate It Properly

By JACK O'DONNELL

WHEN the president of one of the largest textile manufacturing plants in New England walked into his office one morning about a year ago, there was, to quote the file clerk, "blood in his eye."

"Tell Mr. Everson I want him to come here at once!" he directed his secretary.

When Mr. Everson, the production manager, appeared, the boss lost no time in getting to the point.

"Everson, what's happened out there?" and he waved his hand in the direction of the work rooms. "Is everybody taking a vacation with pay? You know of course that production's fallen off twenty percent since the fifteenth of December. What's wrong?"

Everson had been expecting this interview for some time. He had hoped he would have the answer ready if and when the question was asked. But he didn't.

"Everybody seems to be doing his best, there have been no complaints," he told his superior. "I've studied the situation from every angle but I'm as far from a solution today as ever."

The president drummed on his desk.

"**Y**OU'VE done all you can, eh?" he said finally. "Well, I've lost a lot of sleep trying to figure it out myself. We've both failed. Let's give one of these business experts a trial."

A few days later an efficiency expert arrived and after an hour's inspection of the plant went to the president. "You don't need a business expert, you need a ventilation expert," he said. "Your plant is stuffy, overheated and dry."

Three days later the ventilation expert who was called in made his report. In it he said:

"Your employees are listless and

enervated. They have the desire to do their usual amount of work but you are slowly 'steaming' the life out of them. Your shop is overheated. The average temperature throughout the day is eighty-three degrees while the relative humidity is only thirty-seven. Decrease the average temperature to between sixty and sixty-four degrees and increase the relative humidity to about forty-six, and it won't be long before your production is back where it should be."

UNDER the direction of the ventilation expert, every room in the plant was soon thereafter provided with a sufficient number of ventilators, some near the floor, some near the ceiling, to permit the free circulation of good air. The heating plant was changed, or regulated, so that an even temperature of about sixty-four degrees was maintained throughout the day. When the work was completed there were no drafts, yet the air was kept in constant, gentle motion. The steam pipe heating system provided sufficient moisture to keep the humidity at about forty-six.

Immediately there was an upward curve in the production chart. Employees threw off their lassitude, the production manager smiled again and the boss lost his grouch.

IN THE last twenty years scientists have exploded many of the old theories of ventilation. By experiments they have arrived at important new conclusions regarding what actually constitutes good ventilation in our homes.

When about 150 years ago it was discovered that oxygen was taken into the blood through the membrane of the lungs in inhaled air, and that carbon dioxide from the blood was thrown off in exhaled air, numerous erroneous conclusions were

drawn. One of these was that an excess of carbon dioxide, not lack of oxygen, was the cause of asphyxiation in badly ventilated places. Scientists have exploded this theory by repeated experiments and now hold that carbon dioxide in amounts likely to be thrown off in the most crowded room is harmless.

It is true, however, that bad ventilation does exert the most profound effects upon human health and comfort. Crowded, ill-ventilated rooms, such as those occupied by the workers at the New England textile plant, bring on a feeling of dullness, sleepiness, sometimes faintness and nausea. There are classic instances in which bad atmospheric conditions have ended in tragedy. The most famous of these, perhaps, is that known as the Black Hole of Calcutta.

THAT tragedy happened on one of the hottest of hot nights in British India, more than 150 years ago, when a youthful and merciless ruler of Bengal imprisoned 146 English soldiers in a small cell in Fort William. The heavy door of this room, built for two persons, was bolted, and the only air that entered came through two tiny barred windows. The prisoners perspired profusely and were consumed with thirst within a few minutes after the 146 entered.

Clothing was removed, frantic onslaughts were made against door and windows, and the room became a bedlam. Men fought and clawed each other throughout a night of horror, until weakness overcame them. By morning death had come to all but twenty-three.

Thus tragedy remains as the greatest demonstration in history of man's bondage to the air that surrounds him.

For many years it was believed that these soldiers died because the air had been vitiated. (Continued on page 148)

How to Save on Plumbing Bills

A Score of Usable Hints to Add to Your Home's Comfort and Convenience

by

JOHN R. McMAHON

IF THE Egyptians or Chinese invented plumbing, it has remained for America to make bathrooms as common and popular as automobiles. Tubless foreigners gaze at our sanitary wealth, and we gape back at their community washhouses and tin or rubber substitutes for porcelain luxury. The average European palace sports one bathroom, we are told, and when the king is shaving the rest of the royal family line up at the door waiting their turn to enter.

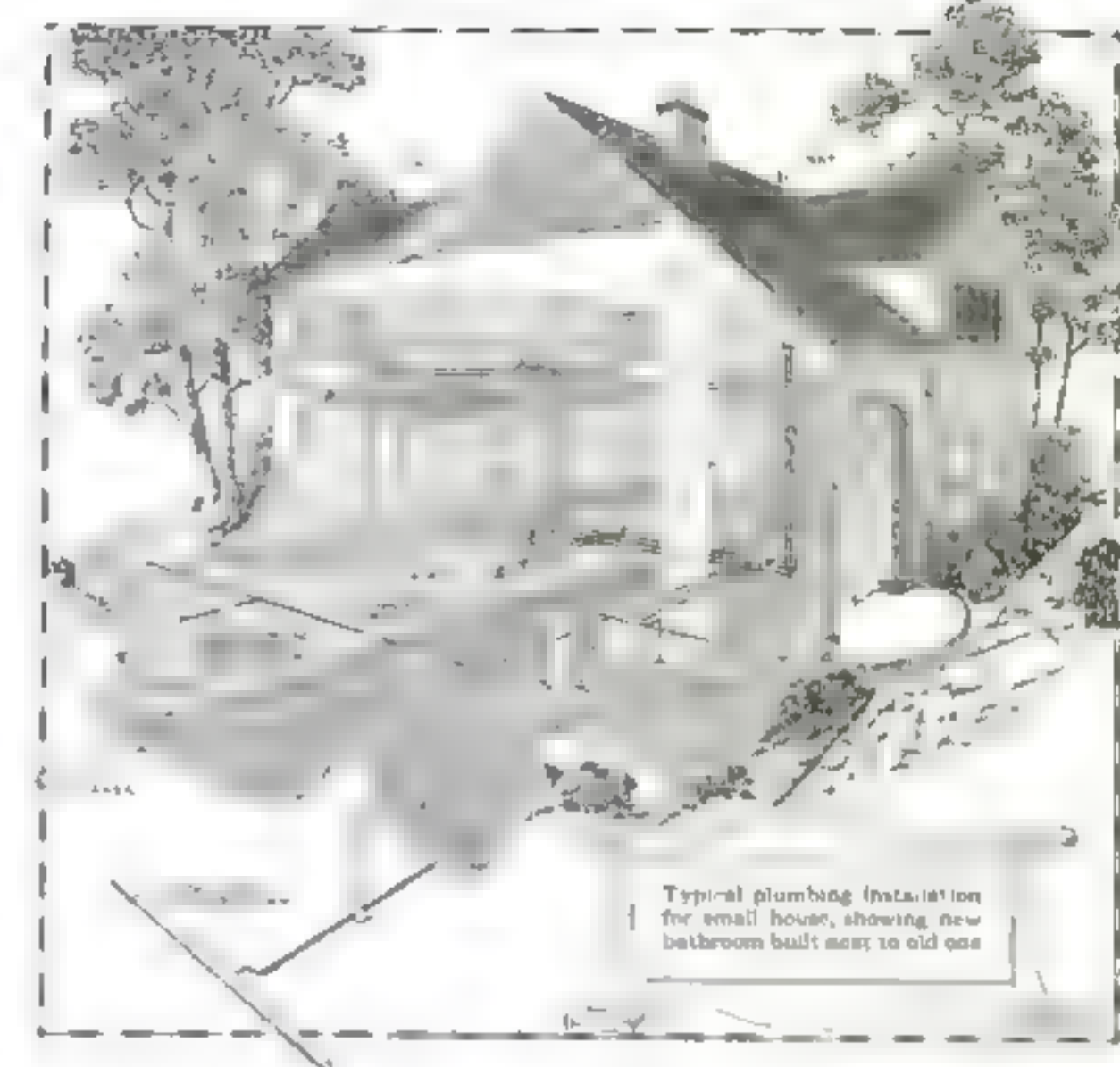
A similar situation arises quite frequently in American households. Here, being unrestrained by royal etiquette, the members of the Smith family roar at one another or at least pass sarcastic remarks. Father is at a disadvantage in the repair-tee, being lathered up and maybe trying out an old style razor. They taunt him with the fact that the Joneses, next door, have two bathrooms. Mr. Smith is bound to yield in time. Thus spreads the two-bathroom idea, which doubtless will become universal practice in another generation. Today builders of new and remodelers of old dwellings are heeding the demand for duplex plumbing convenience.

Is it easy to add a second bathroom to an old house?

YES—provided the present layout permits the new bathroom to adjoin the old one on either side or directly above or directly below. This arrangement would permit the principal piping to be undisturbed or changed only slightly to serve two sets of fixtures. On the other hand, a new bathroom at the far end of the house requires much extra material and labor and may cost more than the present installation. Plumbing is like an iceberg—much of it is unseen; and the hidden part is apt to jolt your pocketbook if you scan only the top works.

What are some of the rearrangements possible to find space for another bathroom?

OFTEN enough space can be taken from a bedroom, a sewing room or even from a



Typical plumbing installation for small house, showing new bathroom built next to old one

hall. It is possible to change stairs and in some instances it might pay to extend the house a few feet. A space only six by six feet will do, as a minimum. Most bathrooms, of course, are on the second floor, handy to the sleeping quarters. Sometimes, in a bungalow, the extra bath is placed in the basement. An outside window should be in every bathroom.

Is plumbing practice today scientific and standardized?

ABOUT as much so as automobile manufacturing. In other words, the kinds and grades are numerous. After all, plumbing in the modern sense dates back only a few decades. Real sanitary engineering is just beginning. The Bureau of Standards at Washington carried out basic experiments in plumbing some five years ago, building a complete house layout with glass pipes so its experts could observe the flow of liquid inside. They even in-

stalled an electric fan beside the roof vent to give the effects of wind on the system. But there is still much to be learned and applied.

Can the home builder rely on city plumbing codes to specify best practice?

IT WOULD be fine if he could. Unfortunately, all sorts of conflicting methods and rules prevail in different parts of the United States. Plumbers are licensed and unlicensed. A house on a boundary might need three styles of lawful plumbing. The inspector who passes the job may hail from the board of health, the building department or the water department. Six permits may be required.

But isn't there any standardized code to fall back upon for guidance in case of conflicting or inadequate laws?

THERE is a Government program for standardized and simplified plumbing formulated by experts under Secretary Hoover and offered for local or state adoption. To a code-tied owner, it offers some advantage by granting additional leeway, or you may be code-free and may harmonize local requirements with the principles laid down by the Government experts in this program. For example, let us consider the big main waste pipe of cast iron. It runs horizontally with a slight slope through the cellar, either under the cement floor or attached to ceiling beams. The outlet is to

Are You Planning to Build?

MR. McMAHON'S services and those of the Popular Science Institute of Standards are available to assist our readers in solving their building problems. Letters will be answered free of charge. Address your letters to John R. McMahon, Popular Science Monthly, 250 Fourth Avenue, New York City.

sewer or septic tank, while the other end should continue full size vertically through the house to project eighteen inches or so above the roof. The whole line is called soil pipe; the upright section is termed the soil stack and, being open at the top, acts as vent as well as receiver of waste discharges. Now the Government experts tell us that the whole cast-iron line can be safely reduced in diameter from the usual four-inch size to three inches. This will save material and labor and facilitate concealment of pipe between the studs of a frame house. The small size fits neatly in partitions, and a three-inch bend is more easily housed under floors.

Are there light and heavy cast-iron pipes of the same size?

YES, extra heavy pipe so-called is one quarter inch thick, standard pipe so-called one eighth inch. The federal scientists say these are two extremes, that we ought to have a pipe thickness somewhere between the two. If this recommendation were adopted along with the lesser size, about 220 lbs. of cast iron and considerable canking lead and labor would be saved on a small house.

Does the soil stack or upright pipe act as vent for the entire system?

IN A small compact layout, it may obviate all other venting. On this point traditional plumbers disagree violently with the scientists. A vent for every fixture, is their classic motto. Costly and unnecessary, retort the modern experimenters. A vent may be even worse than none, when it reduces velocity of flow and so lessens the clean-out of a pipe.

A vent is nothing more than a ventilation pipe which connects with a waste outflow near a sink, bath, basin or such. It either runs into the soil stack or goes upward independently to project through the roof. When you see a roof with a forest of little pipes sticking up, that is evidence of old style plumbing. Small vents are sometimes necessary, it is true,

if a fixture—that is, sink, basin or tub—is more than five or six feet from the soil pipe or stack. Sometimes a distance of eight feet is safe. The horizontal branch pipe connecting the fixture to the main drain or soil pipe should slope one quarter to one half inch a foot. The horizontal line should be galvanized iron with a diameter of one and a half if not two inches.

The larger size is less likely to make trouble by stopping up. It is well to know that all plumbing connections should be made with melted lead, caulked, or with thread fittings, not by drilling and tapping.

Is it necessary to have a trap and fresh air inlet at the exit of the main house drain?

NO. THAT is an old notion which is now in the discard. There is one exception in favor of this trap: it keeps out sewer air.

in the colder northern regions. Otherwise the house trap is a detriment to the efficiency of the plumbing system, hindering circulation of air and the outflow of liquid. It may also cause trouble from back pressure. Once it was argued that this trap barred sewer rats from a house, but we know now that such vermin can navigate through any but a small fixture trap. The fresh air inlet is entirely superfluous. Speaking of the main house drain, it needs at least two screw cleanouts, one at the exit and the other at the bottom of the soil stack. Also, the cast-iron drain should continue through the house foundation and a few feet beyond before it enters any tile to sewer or septic tank.

What about the small fixture traps?

LEAD with wiped joints has practically passed out in favor of neat and labor-saving traps of nicked brass. And instead of the old-time large sizes, it is enough to have a trap with a water seal between two and four inches in depth. Self-siphonage of traps is a bugaboo used by advocates of multiple venting and by inventors of complicated devices which have dubious value. If the water seal is lost by siphonage once in a long time, we no longer believe that a trifle of escaping sewer gas will cause disease. Self-siphonage is more likely to happen with oval bottom fixtures like wash basins than with flat bottom fixtures like sinks and bathtubs. In the first case, the water rushes out with an abrupt finish that tends to drag the seal contents along, while in the second case the trailing finish exerts less pull on the seal.

Returning to ventilation, should the main roof vent be capped for snow protection?

NO. THE escaping gases will honey-comb any snow and pass through. Leave the pipe open. Do not have it located too near a window so that fumes may be blown into the house.

Is it desirable to have a grease trap for the kitchen sink?

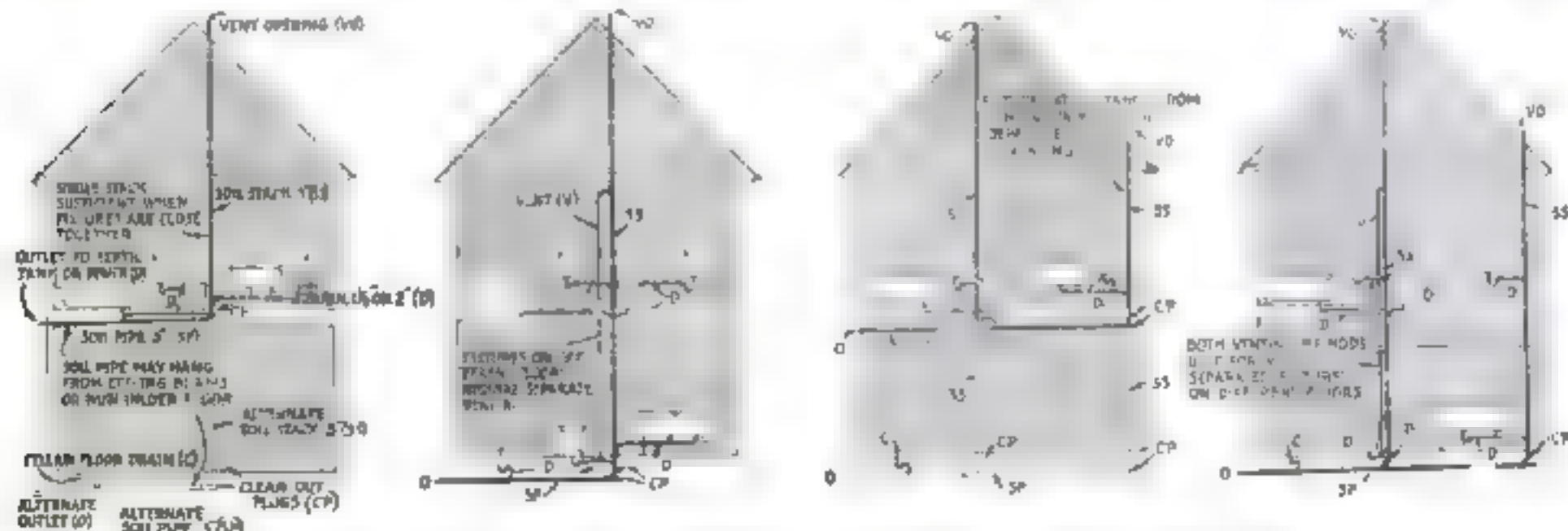
IT IS hardly necessary for a home where there is connection with a public sewer, but is advised for use with a septic tank, because grease interferes with the activities of the liquefying bacteria, and chemicals used to dissolve grease also bother the bacteria. Such a trap requires regular cleaning. Do not try to clean a stopped up pipe with caustic soda or soda lye, which combines with grease to make a hard soap. Use potash or potash lye, which make a soft soap.

How much water is needed for a flush toilet?

THE average toilet takes about five gallons, and the Government authorities say this could (Continued on page 243)

Arrangement of waste pipe in an oval-bottom wash basin which might produce self-siphonage of a fixture trap. The dotted lines show the safer method. The vertical pipe at the right is the soil stack.

An arrangement of bathroom and kitchen sink piping. Small vents are sometimes necessary when the fixture is more than five feet from soil stack.



These diagrams illustrate typical plumbing installations suitable for bungalows and also for small houses of more than one story having only one bathroom. Notice that two vents are provided only where the fixtures are far apart.

Now—Baked *and* Poured Houses

*Clay, Concrete, Steel, Even Puffed Rice
Used by Builders in Novel Experiments*

By EDWIN KETCHUM

WOULD you live in a house of steel? Perhaps your children's children will, and like it, too. In the not-so-distant future, America's millions may be housed in synthetic homes, built in a day, not by ones or twos, but by hundreds; not by hand, but by machinery.

Today experimental houses are going up on all sides, some of steel, some of clay, some of molded concrete blocks. Any one of them may set the style for the homes of the future.

For instance, there is the circular house, result of an interesting experiment by Martin Koerber, of Greis, Germany. The walls of his remarkable house are fastened to a dome-like frame of iron girders. Four days after the brick foundation was in place, workmen had completed the five-ton framework. In a short time the outer walls, which were composed of two-inch slabs of heat-insulating material

were screwed on, and the owner moved in. Entering his dwelling, you would be surprised by the charm of the well arranged interior; you would notice, in particular, how efficiently the builder has used every inch of space between inner and outer walls for cupboards and shelves. Not only is a house like this erected almost overnight, but the iron frame and wall boards might easily be standardized so that a man of moderate means could afford to have one constructed.

Houses of steel offer attractive possibilities for economy. As in the manufacture of automobiles, the parts can be standardized and made in such quantity as greatly to reduce the cost.

AN ENGLISH iron and steel manufacturer, Lord Weir is doing this in Glasgow, Scotland, where in a notable housing experiment he has provided homes for the workmen of that city. His houses are of felt-lined steel plates on a wooden frame; three motor trucks will carry one of them from factory to site, where it is assembled in a few hours. The steel walls are painted to resemble brick, or covered with a thin veneer of artificial stone, to give a pleasing exterior. Such a house of the bungalow type, with living room, two bedrooms,



At left, the clay house shown in the top photograph before the clay coating was applied to the skeletonlike frame.

kitchenette and bath, is said to cost only eighteen hundred dollars to construct.

All-steel houses, frame included, have been constructed in this country also. Doors are punched in the metal supporting members at the proper places, and wrenches instead of hammers put the house together.

One of Edison's pet ideas is the synthetic house, he sees it, not as of steel construction, but as a shell of quick-setting cement, poured at one stroke into a mold the size of the finished house. Could

You wouldn't know from looking at this cozy house that it is made of clay. A recent experiment at Sletau, Germany. Such houses look like brick.

the dwelling be poured at one operation, its cost would be slashed to a minimum.

BUILDERS in Frankfurt, Germany, have carried out a modification of this scheme with striking success. Instead of casting an entire house, they mold it in sections, each section a concrete block eight feet long, four feet wide and eight inches thick. One such block takes the place of 600 bricks, at a tremendous saving in time and labor. The slabs are not too heavy to handle, despite their great size, for Frankfurt is lucky in having a deposit of light volcanic rock that can be substituted for the heavy gravel which usually goes into a concrete mixture. When American architects attempted to build Forest Hills, N. Y. in the same way, using ordinary gravel, it was necessary to employ special machinery at considerable expense to move the massive blocks.

Many kinds of concrete are being tried for home building. Clay is being used in Sorau, Germany. In Amsterdam, Holland, clinkers from the city incinerator are mixed with concrete to form air spaces, small and well distributed, providing waterproofing and insulation against cold and heat. Sweden has another favored mix, which accomplishes the same result. Samples of this concrete were displayed at the Sesquicentennial. And one European engineer has even tried mixing puffed rice with the concrete for the same purpose, presenting the interesting possibility of raising a crop to build a home!

American builders are watching with interest the experiments with machine-made homes, ready in an instant to start turning out the new synthetic dwellings.



Built in 129 hours, complete from top to bottom, this modern concrete five-room house was a feature of a recent Philadelphia exposition.



Illustrated
by
R. C. Strang

The kid's hand rubbed the ribs that had stopped Pat's foot, but he talked to the huge man as though he were every bit as big.

STEEL making is a job for men, not boys, and no one knew it and acted upon that belief more whole-heartedly than big Pat Donnell, the huge man who ruled the open hearth furnaces of Argo Steel. Messengers? He had tried them. They were always getting into mischief, cutting up didoes when they should have been hustling fooling in a place where a moment's carelessness might mean death. Not that Pat would have cared a lot if a messenger boy shuffled off—this after three experiences with them—but that such trifling might take a good steel man too, and steel makers aren't mobbing any timekeeper's gate for jobs.

No more o' them half-baked kids, he had growled to the employment manager on the day the last boy had been fired. "If ya got to send mill mail around, get a man. There's a dozen around here that ain't good for anything else."

A matter that was arranged at once, for Pat Donnell generally got what he wanted. So that when he literally tripped over a half-size edition of manhood that June morning—

He would never have seen the kid at all if he hadn't actually tripped over him. Pat was entirely too busy. And mad. There was a little matter of hot metal, some hundred tons of it, that was thirty minutes overdue, and thirty minutes in the affairs of an open hearth that is shooting for a record has the significance of several tons in a world's history.

Pat was on his way from the mixer, a gigantic traketle of brick-lined steel that could—when it was full—hold a thousand tons of hot metal from the blast furnaces. It was his purpose to find out, in person, just why that ore-melting pig iron tapper of a blast furnace super couldn't live up to certain promises made over the telephone that morning. And from the way he dropped down the steel stairway in the darkness between the towering mixer and the much higher end wall of his half-mile open hearth building, some sort of information would be forthcoming. He hit the ground at a run, whirled through a door amply large enough to permit his exit—it was cut to admit

Midge

by

EDMUND M. LITTELL

A Story of Flaming Metal,
Strong Men, and a Smiling
Boy with a Heart of Steel

freight cars—turned the corner sharply—and tripped. His heavy foot thumped hollowly against something in the middle of its stride, and the grunt that it extracted was half-drowned by his growl:

"What the—?" There is no telling how that beginning would have ended, for Pat's facility with language was equaled only by his accomplishments as a superintendent, but his surprise was that of a boy—

He scrambled to his feet, and even then his chin was no higher than the belt that girded Pat's mighty waist. His hand was rubbing the ribs that had stopped Pat's foot, his eyes, great brown ones that had some pain and some fear in them, looked up into the face of the giant.

"Hurt ya, kid? I'm sorry."

"Naw, scared to death, that's all," with a grin.

The kid talked as though he were every bit as big as Pat, and in spite of himself Pat met him on the same ground—though his lips twitched the least bit and the great voice that could bellow orders down a heat-soaked charging floor was a bit softer than usual.

"Then what ya blockin' traffic for?"

"I wasn't blocking traffic, I was tyin' my shoe," said the kid bravely. "You're Pat Donnell, ain't ya?"

"Yeah, an' I hate boys—in a steel mill. Who let ya in?"

A whistle shrilled and Pat looked up to see a switch engine drawing six smoking ladle cars of hot metal. That meant that he could postpone his conference with Peter Harper until a more convenient time and turn to one of the dozen other things that wanted doing. But first to get rid of the kid.

"**N**OBODY," the midget was saying. "I sneaked in."

"What for?" sternly. Pat was wondering if there ever was a fence made that could keep out inquisitive youngsters.

To watch 'em make steel," said the kid with a "what do you think?" sort of an air.

"An' interfere with the men that's trying to make it," added Pat. "Now you—" he was about to say "beat it," but he stopped. The very evident concern in those brown eyes was responsible.

"Ain't that my luck?" muttered the kid, and looked disgustedly at the ground. "I was—layin' for you, and now I'm in wrong."

"What for?" The train of ladles was pulling into the building, and Pat was impatient to be about his affairs.

"To ask for a job. I been tryin' at the timekeeper's gate but they laughed at me. So I got in, an'—" he stopped and lowered his eyes to inspect the movements of a discouraged toe.

"Well, there ain't no job for ya," growled Pat. It took some courage for him to say it into the wistful face of the kid, and he qualified it by adding: "Ya can do one errand for me—on yer way out. Know where the blast furnaces are?"

The boy looked up with brightening eyes. "Sure. There," he

pointed. "An' this is the open hearth, an' there's the bloomer, an' next comes the twenty-inch mull, an' the machine shop between 'em, an'—"

"How'd ya get all that?"

"Askin' questions—an' peepin' through the fence."

"H-m-m! Well, beat it to the blast furnaces. Find Pete Harper he's the boss. Fat an' short like a keg. Tell him I got a mixer here that holds a thousand tons an' I want it kept full. We're shootin' fer a record this month an' I ain't got time to worry about his job. That's all. Then you can clear out."

THE kid was gone. Like a streak. If his twinkling legs meant anything at all they conveyed the impression that a certain boy had been given a nickel for candy and that the store was much too far away. Good riddance. And he wouldn't show up again, for when that hot-headed Pete Harper got through chasing him out he'd run faster than that. And Pat turned through the big door to see that the hot metal went into the mixer at once so that Number Four furnace could be fed without draining the reserve supply.

The second of June. The month without any holidays—and twelve open hearth furnaces, ad of them going. Not one furnace down for rebanding, none that promised to burn out, and every one of those two-story brick houses for fire manned with a good crew. A perfect combination for the breaking of a tonnage record—if nothing went wrong—and the records of Argo Steel were mighty hard to break, for Pat had outdone himself so many times. A small boy? Less important to Pat than the state of the weather in Timbuctoo. Get out the tonnage!

Until, as he was turning away from the inspection of a new batch of metal in the mold yard, a hand plucked his sleeve. It was that infernal kid again.

"He told me to tell ya that he's after

records too," panted the boy. "An' if ya don't like the way hot metal's comin' over, ya better go run the blast furnaces yerself. Ya'll get five more heats by night an' if you don't watch out ya'll have to build an addition on the mixer. Says ya can't bully him, an' he'll have it out with ya anytime."

So saying the kid dropped in a heap. Such a tiny little heap!

A broken rib, the doctor reported when they had rushed him to the plant hospital, and Pat recalled several things. The kid's hand had never left his side during their talk at the rear end of the open hearth building, his pointing out of the various buildings had been done with the left hand, his eyes had not lost that look of pain, even as he swung joyously away on the errand; his face as he panted out Pete Harper's retort had been white. A heavy foot swinging with angry haste, small ribs—and trouble. Confound all boys!

Doe was throwing a bandage around the kid when his eyes opened—and Pat looked into wells of regret.

"I'm a lot o' trouble, ain't I?" he tried to smile, but his lips trembled. "Never will get a job now."

PAT snorted—a great assumption of anger. "Why didn't ya beat it when I told ya to?" he growled. He was thanking his stars at the same time that the kid hadn't for that rib might not have received the proper sort of attention.

"How could I?" demanded the boy. "Pete told me to tell you."

Pete told him to! And he did! With a broken rib that stabbed with every panting breath! Pat's aversion to boyhood was slipping.

"How'd ya find me in the mold yard?" he asked.

"Kept huntin' till I did." Perfectly simple, why ask such a foolish question? his tone said.

"An' what might yer name be?"

"Ball. Tom Ball, Junior. My father—" he stopped.

Tom Ball! One of the best first helpers in Pat's crew—until not so long ago. So intent upon his work that he had forgotten the ponderous advance of the charging machine. Burned the same day. And this was his kid!

"How old are ya?"

"I been goin' on sixteen."

"An' ya want a job workin' fer me, eh?"

The light in the brown eyes was more than sufficient reply. Fortunately, for his lips were trembling again.

"Well, ya get one," Pat hastened to say. "On trial mind ya," he added gruffly. "Hustle up an' get well an' I'll give ya a week. One week, that's all. An' if ya don't make good—" he stood up and looked away from the brown-eyed gratitude that was robbing him of his manhood. "Ya'll have a time card beginnin' today," and he was gone, closing the door hastily behind him.

BACK to work. Two weeks of it. So strenuous that there was little time to think about a boy. Twelve furnaces, thousands of tons of materials—and a hundred tiny men, lost in the immensity of the huge building, to put them together. The furnaces, all right—so far; the men, driving along enormously in emulation of Pat's example, the materials by the trainload, and the steel in rivers of fire. The record? One whole heat—one hundred tons!—better than his best previous record for this time of the month. A tremendous gain! If it kept up this way maybe



Midge leaped sideways from his perilous perch and fell into the speckle arms of Butch, the giant shovel swinger. Butch gave the boy a mighty hug and set him on the floor.

they could bust their record by three or four heats! Big Pat leaned back in the chair that creaked beneath his weight—and added a fifteen-year-old boy to his cars.

"Say, when that half-sized chunk of an errand runner stood up to me an' yelled fer hot metal I had to look twice to see him an' cuss a streak to let him know who was boss!" That was what Pete Harper had said to Pat Donnell the day after the kid's call on him. Keg-shaped Pete and tree-trunk Pat were the best of friends—except when hot metal failed to arrive on time. "Why, I'd ha' been scared to turn him down! The little shrimp might ha' got busy an' tapped a heat himself! An' a hustled rib, too!"

AND now Pat looked at the small bundle of eagerness that stood in the door grinning at him, ran his blunt fingers through steel-colored hair until they rasped—and grained back. Involuntarily. Until a thought of those previous messenger boys intruded itself and he assumed the role of boss.

"Well," he growled, "ya're back. I bet ya all right!"

Not a very warm welcome, this. But the boy failed to notice it. He was busy holding down the safety valve on something of importance.

"Sure," then he popped. "The ladle-kin' gang's runnin' out o' fire clay an' there's two carloads spotted at the stock house but they ain't unloaded yet," all in a breath. "Want me to get some over?"

Old news to Pat, who had a way of picking such information out of the air. The stock house was to have been his next point of call—but he failed to mention it.

"Isat so?" was what he said. "Yeah, guess ya better see what ya can do about it. Tell 'em I sent ya."

YEARS ago, when Pat himself was a small boy, he had been the proud possessor of a pup that was happiest when retrieving tossed sticks. He thought of that pup now as he watched his new employee tearing down the floor. The outside edge, where a cleared space permitted rapid going. Whether or not the stick would be brought back was something yet to be seen. In the meantime, Pat charged out of his cubby-hole of an office to the places where real work was being done. And by a strange coincidence, he happened later on to be passing by the stock house, a train shed of a building that housed the miscellany of steel making equipment, when a gruff voice hailed him.

"Did you send that grinnin' midget out here after fire clay?" demanded a wild-eyed foreman. Pat nodded. "Well, ya're gettin' it! But don't blame me when Pod Horton kicks about not gettin' his recarbuzer on time!"

Pat's elevated eyebrows asked a useless reason why. Useless because the foreman's tirade had not stopped. When the cuss words were all sorted out his report was quite brief. The midget had come bearing an order for fire clay. "Said you wanted it right off." When told of the urgent need for recarbuzer, he had maintained stoutly that fire clay must come first. "Said you said so—an' I tried to get ya on the phone to check him up." A shrug of the shoulders indicating the hopelessness of such an attempt to find Pat in his office. "An' now Pod Horton's raising Cain—there's him now, callin' me up fer the millionth time!"

Pod Horton, the fat man who was melter in charge of four furnaces, had to be soothed at once, and that Pat did. After which he wanted to know where the kid was.

"If he ain't out there kiddin' them fellas into shovelin'

faster," snapped the foreman, "he's prob'ly ridin' the dinkey tram back—sittin' on the clay! Mind ya," he shouted after a departing Pat, "I'll do what's ordered around here, but I'll be everlastin'ly blasted if I'll stand fer any more lies from that kid!"

So it was that Pat had a chat with a crestfallen boy. At the rear end of the pouring floor behind the mixer, where a load of fire clay was being dumped. The tapping of steel was more important than the lining of ladles, he conveyed, and steel can't be tapped without recarbuzer. It was exceedingly fortunate that Pod could borrow some from another furnace; the gunning for a record was therefore not delayed. "Not that ya didn't do what I sent ya to do," Pat concluded. "Ya didn't use yer head, see? An' that'll get ya in trouble every time."

Once more a discouraged foot scraped at the ground. "Aw, I guess I'm nothin' but trouble," said the boy. "I better—"

"Quitte are ya?" growled Pat. "Can't listen to yer better! Yeah maybe ya'd better quit" and his keen eyes looked deep into the upraised brown ones. They wavered, then steadied.

"Naw," he said. "Ya gave me a week's trial, I'll stick. What'll I do next?"

PAT shrugged his great shoulders. "Find a job," he said, and nodded toward the clean-swept boulevard of pouring floor with its row of twelve two-story houses eighty feet wide that lined the mixer side, shutting off the sight of laboring gerys that worked in front of them on the elevated charging floor. "There's twelve furnaces, an' a lot o' men, shootin' fer a record. If ya can't help 'em out—don't ask me what yer job is."

That was a fairly large order to hand one small boy, but Pat had a way of submitting men to tests, why not a boy? Especially one who—at the start—had shown such an ability to find jobs for himself.

The week, a heat-ridden, bone-melting series of days, passed slowly into history. Days when a blazing sun beat down upon the fifteen-acre roof of the great building and dazed those twelve furnaces to equal it. They did—and bettered it. The men labored, charging into the two thousand degrees of incandescence that burst from open furnace doors with the flying shovels of bottom making, tending the rivers of fire that were tapped out of the

opposite sides and cascaded twenty feet into the huge ladles set in the under pits beneath, turning exhaustedly away from their labors to seek a coolness that could not be found. The twelve high-backed wooden benches on the outer side of the charging floor might as well have been placed in front of the furnaces, they were warm and there was no breeze. Only a heavy breathlessness of shimmering heat waves beyond the open outer wall, a glaring brilliance of summer sun that dazzled tired eyes. The crystal clear water that pulsed coolly from water pipes into the twelve near-by water tanks was a tepid disappointment. It was warm, as though the pipes through which it came led down from the scorched roof instead of up from the earth that should be cooling.

SEVEN days of such weather—and the tonnage record slipping. If only the weather would break. A black bank of clouds, the crash of summer lightning and rain in sheets could cool the parched and cracking yard and bring relief to the men who needed a breeze if ever men did. But no. And instead of one heat ahead, the record (Continued on page 345)



A the smokekeeper's gaze they laughed at the kid when he asked for a job—and so he soaked in

How Great Inventions Are Born

Strange machines that preceded automobiles, telephones, submarines, and their contributions to today's marvels

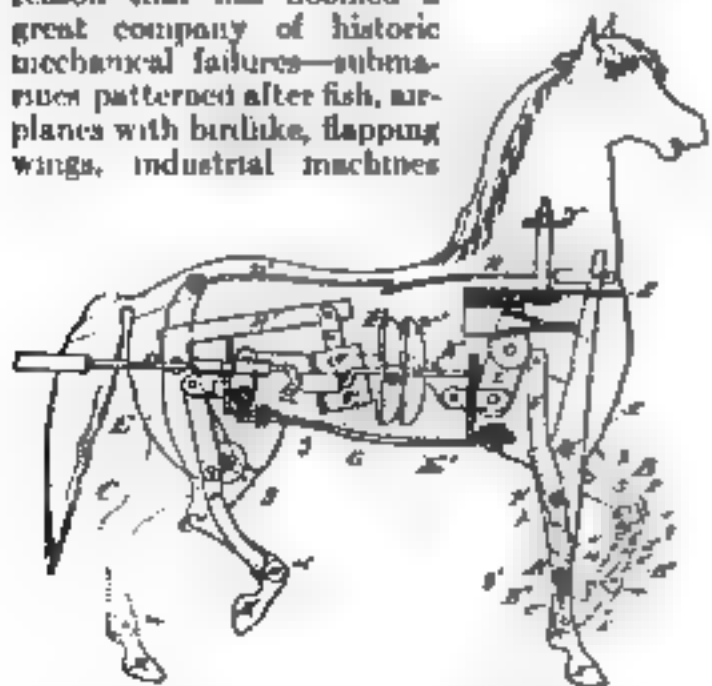
By AUBREY D. MCFADYEN
Associate Examiner, U. S. Patent Office

PERHAPS no task an inventor can set for himself is more difficult than an attempt to model a mechanical device after a part of the human body or a living animal. And yet preliminary efforts toward great inventions have almost always attempted to simulate animate objects in appearance or in action. A recent search through the records of the Patent Office disclosed scores of such fantastic starts.

In 1808 an inventor brought to the Patent Office in Washington drawings of what he called a "walking vehicle." This unique progenitor of the automobile was supported on four legs, actuated by a steam engine to walk after the fashion of animals. Scarcely had he departed with his patent when two other men appeared with drawings depicting a "steam carriage."

"Our carriage has only two legs and walks like a man," they announced. And there, between the shafts of a cart, stalked a steam-driven "man." The body of this strange automaton served as the boiler. An engine just behind the body actuated the jointed legs through a system of levers. Steering was accomplished by a rope encircling the body.

These inventions did not seem fantastic to the men who designed them. At that time, what could have seemed more logical than a walking carriage, or a car pulled by a mechanical man? The inventors had never seen a motor car. That neither of these "walking vehicles" apparently ever attained practical utility or financial success was due to the same reason that has doomed a great company of historic mechanical failures—submarines patterned after fish, airplanes with birdlike, flapping wings, industrial machines



Doyle's "power horse" for drawing vehicles—described by Mr. McFadyen as "mechanically almost perfect." It never attained practical utility, but proved to be a forerunner of the automobile.



A typical "flying apparatus" of the kind designed to imitate the flight of birds, patented as early as 1871 by a Delaware man. Inventors are still working on this line.

imitating the operations of human workers. They followed too closely and laboriously the animate thing they intended to replace. Even today, no doubt, some inventor is wasting his time and ingenuity on a machine of similar nature, by making the same mistake.

For from an extended survey of such inventions may be drawn a precept of invaluable aid to inventors. It is this:

Whenever an inventor attempts to replace flesh and blood with a machine, he must discard every semblance of animal motion, and draw upon his own imagination for the movements of the machine. In short, like the poet, the true inventor must draw from airy nothing.

Few persons, of course, have the vision to throw overboard an accepted way of doing a thing and to build a machine that does it in an entirely different way. Yet, as the history of inventions shows, it is the capacity for doing so that has produced many of our mechanical marvels.

A typical illustration is a device known as the "hand knitter."

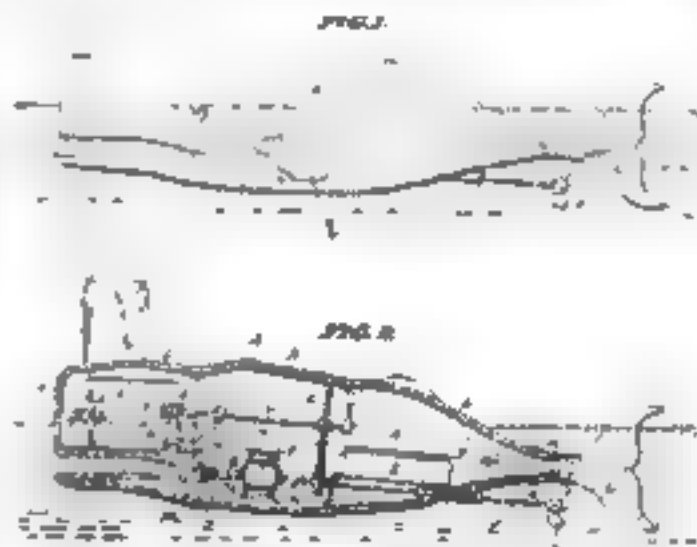
THIS device consists of scarcely more parts than the fingers of one hand. It can tie a knot incomparably quicker and more accurately than any pair of hands. Yet it bears no resemblance either in motion or appearance to the hands it displaces. This machine is practical. It achieves its purpose through the employment of recognized mechanical principles, while other similar machines that imitate the

complicated movements of human fingers have been failures.

About the simplest function that the human hand is called upon to perform is merely to open and shut—to expand and contract as in the act of milking a cow. That this manipulation is most difficult to reproduce mechanically is apparent from a study of a milking device that contracted jointed "fingers" by wires pulled taut by rotation of a crankshaft arranged in the "wrist" portion, and to open the "hand" by springs when the tension on the wire "muscles" was released. Although known to the

public for more than twenty years, this apparatus appears never to have gained the favor of dairymen, and we can only impute this to one reason: it would not do the work of the human hand.

SUCH inventions as these were not intended as toys. Quite seriously their inventors tried to simulate the



In this mechanical whale, patented by a New Yorker, even a spray was provided to add realism, and the whale's skin was imitated by cork. Z indicates the steering wheel and O the rudder. It was propelled by electric motor B, driven by battery E.

natural movements of their animate models, confidently expecting that a machine could perform the same operation in the same way. Thus, early attempts to construct a sewing machine imitated the act of hand sewing. A single thread was passed back and forth through the material to produce the simple "running stitch." A device of this kind patented by Benjamin Bean in 1843 appeared only three years before Howe produced the forerunner of the modern sewing machine.

Bean's "Machine for Sewing with a Needle" was hardly more than a pleater or crumpling machine. The material was crimped between meshed gears to pro-

duce undulations, and a curved needle was placed so that its point rested in a groove between the gears where the undulations were formed. Thus no sooner were pleats formed as the gears were rotated than they were unpleated upon the needle. Such devices are now called "short thread" machines, because they can make a seam of only limited length.

The success of Howe's machine was due largely to the fact that it functioned differently from the movements in sewing by hand. It even introduced a new stitch!

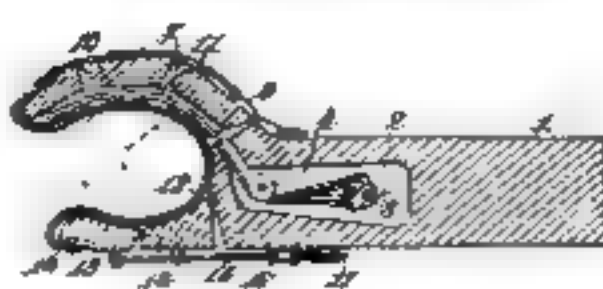
The typewriter presents a similar story. The Patent Office records show that as far back as July 23, 1829, a patent was issued to W. A. Burt for a typewriter. Burt's "typographer" as he called it, worked somewhat like our present toy machines, that is, it had a movable dial that was twisted to bring the desired character under an impression hammer.

IN 1843 Charles Thurber of New London Conn. obtained a patent (No. 4271) for a "writing machine or mechanical chirographer"—a highly ingenious apparatus which literally wrote the characters by longhand with a pen. The general construction of Thurber's writing machine is fascinating. For the production of each character the pen was actuated by a separate pair of cams which traced the script letter by a combination of vertical and horizontal movements. The operating keys for this imposing mechanism were arranged "as in a pianoforte."

Here the reader unconsciously draws upon his hindsight and chuckles, wondering how anyone could have devised an elaborate contrivance to write out a letter which could be printed instantaneously simply by pressing a key. But great inventors have done things which, in the light of subsequent developments, seem even more ridiculous. In his youth Alexander Graham Bell built a talking machine with rubber vocal cords, a movable mouth, and a bellows for directing air impulses against the cords. Recalling this years later, Bell explained that by forcing air through the device with one hand while manipulating the mouth with the other, he finally managed to elicit an articulate "Mama!" to his great edification.

SCORES of other inventions register the tendency of man to copy the things he knows. The primitive catapult which hurled stones too heavy for the arm of man, the early washing machine which simply rubbed the clothes back and forth on a washboard, the propulsion of steamships by mechanical oars after the fashion of the ancient galley, and the mechanical diggers for spading up the farmer's field, are shining examples.

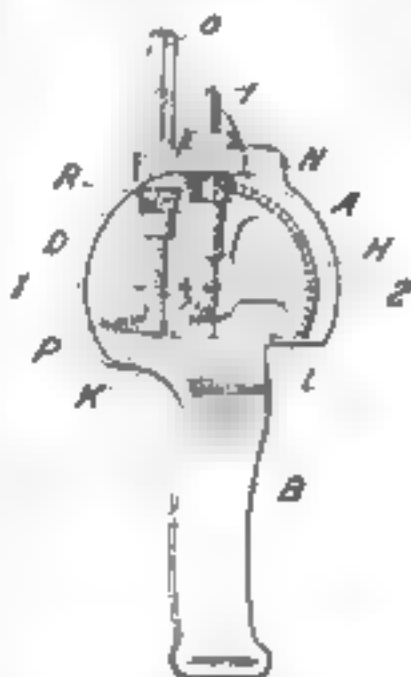
But mechanics and anatomy have little



Fingers and thumb of the human hand were closely followed in the mechanical hand, patented as late as 1906 and intended for milking cows. Later a milking machine that dairymen used more generally bore not the slightest resemblance to the human hand.

in common. An inventor may obtain valuable points from a study of the animate things he seeks to supplant, but the commercially successful machine almost invariably effects the result in a wholly different way from the living model, and in accordance with approved mechanical principles.

The linotype machine is a conspicuous example. In 1893 a typesetting machine was introduced. It required 163 sheets of patent drawings to portray the invention. At an expense of several million dollars, two of the machines were constructed. Mark Twain is said to have invested his entire fortune of \$400,000 in the enterprise.



This ingenious "hand knitter" ties knots more quickly than human hands, by employing recognized mechanical principles. The strings are caught by parts O and I, and the knot tied by pressing on a lever.

tles were picked up and transported to the tuft sockets by mechanical fingers, the other employed slides reciprocated by cranks. The latter machine operated at ten times the speed of the former, and with greater precision.

Perhaps the steam shovel of all the successful inventions, approaches nearest to animate motion. Controlled by a skilled operator, its movements as it advances, recedes, and swings, bear an uncanny likeness to a huge shovel in the hands of a giant laborer. But this is not an automatic machine. No mechanism can take the place of the operator,

EACH machine was about eleven feet long and weighed two and a half tons. In operation, it set up ordinary pieces of type from a magazine, after the fashion of a compositor at his case, and it also distributed the characters to the magazine after use. Hardly had the machines been installed, however, when Mergenthaler brought forth his linotype. Almost overnight the original enterprise collapsed in favor of the simpler and more practical machine which composed and cast solid lines of type.

Recently in a test two automatic toothbrush making machines were operated side by side. In one machine tufts of bristles were picked up and transported



First typewriter patented in the United States, in 1829, from the original drawing. It resembles our present toy machines with twisting disks.

whose dexterous hand, its strength augmented a thousand times by powerful machinery, actually wields the shovel through a maze of levers and valves.

Whoever reads the specifications for some machine that has long since lost its last resemblance to any animate thing must wonder whether he is dealing with mechanics or anatomy, so saturated is mechanical terminology with names of parts of the body. Just as the unrounded and functionless letters in certain words point out their origin, so the anatomical terms persisting in a machinery part may reveal its history. In the strain shovel, "handle" lingers as the proper designation for the beam that carries the scoop, while counterparts of the names "arm," "leg," "finger," "knuckle joint," and "jaw" may still be recognized in various machines. It was a long time before the "horseless carriage" became the automobile.

Before the automobile, many inventions of mechanical horses were turned out, imitating the movements of the animal to an astounding degree, particularly the invention of John Doyle. Doyle, like many others, put the boiler and engine in the body of the vehicle itself and a shaft transmitted power to the driving mechanism within the body of the horse. It seems strange to a modern person that inventors of that day did not apply the power directly to the vehicle's wheels. It was beyond the imagination of these men to conceive of a car without a horse.

What proved to be the basic automobile patent was finally granted to George Selden, of Rochester, N. Y., in 1895, after action on his application had been delayed for seventeen years. Selden's "road locomotive" was propelled not by steam, but by "a liquid hydrocarbon engine of the compression type"—in short, a gasoline engine.

IF ONE unfamiliar with recent automobile history were asked to decide whether Doyle's mechanical horse-drawn vehicle or Selden's horseless carriage possessed the greater possibilities, it is almost certain that he would choose the finished construction of Doyle in preference to the crude Selden machine. For Doyle's "power horse" is about as nearly mechanically perfect as such a construction can be, while the crudity of Selden's structure can be fully appreciated by comparison with the present automobile.

Incredible as it may seem, for years after the introduction of Selden's road engine, inventors kept reverting to the old horse design. One followed Doyle's idea by having the horse mounted on wheels in front of the carriage. Within the body was a gasoline engine that drove the horse's wheels, and it was controlled by reins! In 1904 an automobile carrying a dummy horse attached in front was made, with the idea that it would not scare horses. Also its glass eyes lighted the road by an oil lamp concealed in the hollow head, and the body served as a receptacle for tools.

Cheating the World's Woodpile

How Science Converts Scrap into Wallboard, Chairs, Silk Neckties, and Countless Other Things for Our Use

By

ORVILLE H. KNEEN

TODAY, despite all metallic competitors, the wood used annually by the United States alone, if nailed together, would make an Atlantic City boardwalk reaching from the earth to the moon! In lumberman's language, that would total fifty three billion board feet (square feet one inch thick). And this does not include wood fuel, which is fully as great in volume, making in round numbers a hundred million cords every year converted into gases and heat.

Heaped up in a gigantic pile, the wood we burn every year would represent a pyramid a half mile high and three quarters of a mile square at the base—a greater pile than all the automobiles ever manufactured would make!

This being an age of waste reduction on an ambitious scale, I set out to see what efforts are being made to convert fuel wood into more permanent forms for the needs of man.

First I went to the woodworking shops—large shops and small, filled with buzzing machines whizzing at incredible speed. In one of them I watched a surfacing machine operate before its blower system was installed, in a few hours the



Above: logs piled on an ice-covered river in British Columbia, waiting to be floated down to the mill.



20 FT. WIDE
2 FT THICK

A gigantic boardwalk from earth to moon could be built of the wood used in one year in the United States! Yet this represents only about 25 per cent of the wood actually cut.

operator was completely buried in chips.

I think of all the lathes, planers, shapers, band saws and other machines in the same shop, and then of the 25,000 or more woodworking plants, from lumber and planing mills to box plants, sash and door mills, furniture plants and other shops which shape wood, and you have some idea of the enormous quantity of wood waste the nation produces. Great bins are filled daily, from hoppers, chutes, carts and conveyors, often piled a runnle outside, are the sign "Free Wood" is a common sight on factories as well as buildings under construction. It has been said that as much wood is burned in this country as is used for all other purposes combined.

I soon found that a new conception of waste is permeating industry, the waste of production is being looked upon as merely "raw material in the wrong place." As the manager of a paper converting company in Los Angeles told me, there is a market somewhere for virtually everything in the waste pile. Waste for one factory may be the indispensable raw

material for another. An example of this I found in an enterprising California concern which has perfected a "machine with brains." This machine takes mill ends and odd pieces, converting them into box boards and even portable houses. Two of the machines in tandem are said to have produced 20,000 box ends a day, which would box many an orange and make a deep hole in many a scrap pile!

NEXT I went to the mills themselves, and found that a number in different localities are busily working up their own odds and ends to the order of furniture factories and automobile makers. The "cut and trim" shops work up knotty and partly defective pieces and turn out finished parts on a large scale.

California scores again in this line, for several mills there are converting redwood, sugar pine and white pine waste into such finished articles as sash and doors, and even coffins. In one mill, at Chico, the waste trimmings around knots and defective places are made up into matches. Probably the waste from those matches goes into toothpicks, and so on ad infinitum, down to wooden cuts and the little shivers we see in "oatmeal" wall papers! By that time, if the process is carried out, the waste particles are quite small enough for wood pulp.

This sequence is by no means as fanciful as it sounds. Within a few years there may be expected a grouping of lumbering and woodworking plants, controlled by chemists and experts, which will scientifically reduce a tree to its useful parts. Such a plant might take a Douglas Fir, for example, and utilize its trunk for lumber for a couple of houses, the bark for wallboard or filler for paper, the trimmings for lath and "hogged fuel" for power; and charcoal for stock feed and other uses. From the branches, top and stump resin, turpentine and other chemicals would be extractible, leaving more charcoal. Larger pieces of wood could be ground up for wood pulp, for wrapping paper and newsprint. The liquor from the pulp mill might be used as a fodder for the sawdust, thereby converting the last left over into a fuel!

THIS in one plant the upturned tree might be utilized from root to bark.

Today it is good logging and milling when forty percent of the tree as it stands is converted into usable lumber. About thirty-three percent is the average. At least one quarter of the lumber is lost in making the finished article, so the useful material averages about twenty-five percent of the tree. Thus we have a long way to go in reducing the seventy-five percent of waste.

A mill in Northern Minnesota became almost bankrupt as the commercial timber grew scarce. Yet great piles of short lengths accumulated, for which no market could be found. One day the bookkeeper had an idea, and he told the directors. In desperation, they accepted his plan, and today the bookkeeper is

head of a thriving box factory, with plenty of material in sight and with a good demand for the output among fruit and other box-using industries.

OF COURSE, even the box maker has his scrap and his disposal problem. It will snow him under, unless it is someone's business to use it. A good example of this occurred in the state of Washington. Two box plants doing a good business began to be worried with their great piles of scrap, kiln-dried ends of spruce and trimmings of all kinds. City markets were too far and the small town kindling boxes were all full. One day a paper man came along, with a knowledge of eastern demand, and raised enough money to build a pulp mill on the site of the great scrap piles. Today carloads of dried pulp depart regularly for the great eastern mills, there to be made up into high-grade papers.

"Chewed-up wood."



as pulp may be termed, is one of the final uses for wood. I wanted to find out the uses for cellulose as nature made it, now converted into chunks of various sizes and shapes. So I went to the Ford Motor Company, where I found something like the last word in wood utilization.

Here, where metal reigns almost supreme, the various plants use daily the equivalent of sixty miles of boards a foot wide by one inch thick, purchased in planks one to three inches thick. But the layout man gets no use, straight, hard-



One of the huge barbers with which Western lumber mills destroy their wood waste, though in many instances such scrap is now being utilized as raw material for charcoal or distilling chemicals. (Left) Logging Douglas Fir in the rich forest lands of Washington.

wood plank. He gets the slab just as it was sliced from the tree—bark, knots, curves and all. He is trained to stretch those slabs to the

last eighth inch, and he lays each one out for the greatest possible number of odd-shaped pieces which can be worked into the slab, much as the leather cutter works into the flanks of his hide.

He works around the knots, curves and bad places, and from his slabs he gets an average of sixty percent of total footage actually turned into parts. Odd-shaped scraps that cannot be used up for body parts are converted eventually into small handles, spools and other salable articles. Each foreman is held personally responsible for his scrap pile. There is some waste, of course, which cannot be used for any articles. This is used for power.

Each year this (Continued on page 162)

We'll Soon SEE *by* Radio, Too!



The television projector, with which Dr. E. F. W. Alexanderson, famous engineer, offers us the startling possibility of seeing distant scenes flashed simultaneously, in motion, on a screen before our eyes. Dr. Alexanderson is shown pointing to the cluster of seven lights reflected from a mirror, which form the key to his invention.

SITTING in an easy chair at home some day soon, you may watch with your own eyes an exploring party break its way through a jungle thousands of miles away—or witness a revolution in some remote republic—or glimpse the face of a friend in London or Paris! For these marvels of television—which is “seeing at a distance”—seem at last on the point of realization.

When Dr. E. F. W. Alexanderson, in the General Electric Company's laboratory at Schenectady, N. Y., threw a switch the other day that set whirling a huge drum edged with flashing mirrors, seven dancing points of light on a silver screen bore witness that he had swept away one of the few remaining obstacles to wireless sight. Here was the climax to achievements of scientists the world over, in England, France, Germany and America, lending their wizardry to the baffling problem of television.

In the actual production of practical radio motion pictures, scientists now believe that the perfected system must follow a method somewhat as follows:

With a lens such as that in a camera throw an image of a moving person, say on a square screen. Divide the screen into thousands of little squares. Change the lightness and darkness of each of those squares into radio waves and send them whizzing through the ether to the receiving station. Then transform the radio waves back into dots of light and assemble them on another screen, following the original pattern. At the receiver you will see the person moving before the transmitter, miles away.

No one actually separates the screen into those thousands of little

squares. A speeding act of whirling mirrors or lenses, such as Dr. Alexanderson has invented, successively picks up the light from each square, and through an electrical cell sensitive to light relays a radio “message” whether each spot is light or dark. At the receiving station a radio apparatus picks up the messages and controls a light bulb, making it glow when the radio says “light” and extinguishing it when the message comes “dark.” From this bulb, beams of light ram off a revolving mirror, like that at the

transmitting station, to dash back and forth over the screen, blinking as they go, and weave a pattern of light so rapidly that the eye sees it as a duplicate of the image on the transmitting screen.

WITH different, slower apparatus this method transmits still pictures by radio today. Using selenium and other sensitive cells, it has long been known, light may be turned into radio waves. Thus Dr. Alexanderson himself has transmitted a moving picture film, one picture at a time, in a few minutes. But that is far from a machine that will show you what is happening at a distant point, as it happens.

A motion picture is produced by flashing on a screen in succession sixteen pictures a second, to give the illusion of a nonflickering picture actually in motion. Imagine the speed that must be attained to transmit by radio the hundreds of



This French invention would make it possible to see the person you're telephoning to! The receiving screen is a coated glass placed under the rays of a cathode tube. Magnets swing the beam in step with the transmitter.

Amazing Projector to Paint Distant Scenes on Screen

By ALDEN P. ARMAGNAC

thousands of dots needed to make sixteen pictures a second!

It is in this speeding-up process that Dr. Alexanderson's projector makes such remarkable progress. By multiplying the number of points of light to seven and then using a revolving drum with mirrors, each a little more tilted than the last, to sweep the light in parallel streaks across the screen and cover its entire area in an incredibly short time, he has indicated how it is possible to produce the 300,000 dots a second that will be needed to produce a continuous motion picture.

All that remains is to obtain a radio wave that will transmit this staggering number of impulses each second—a

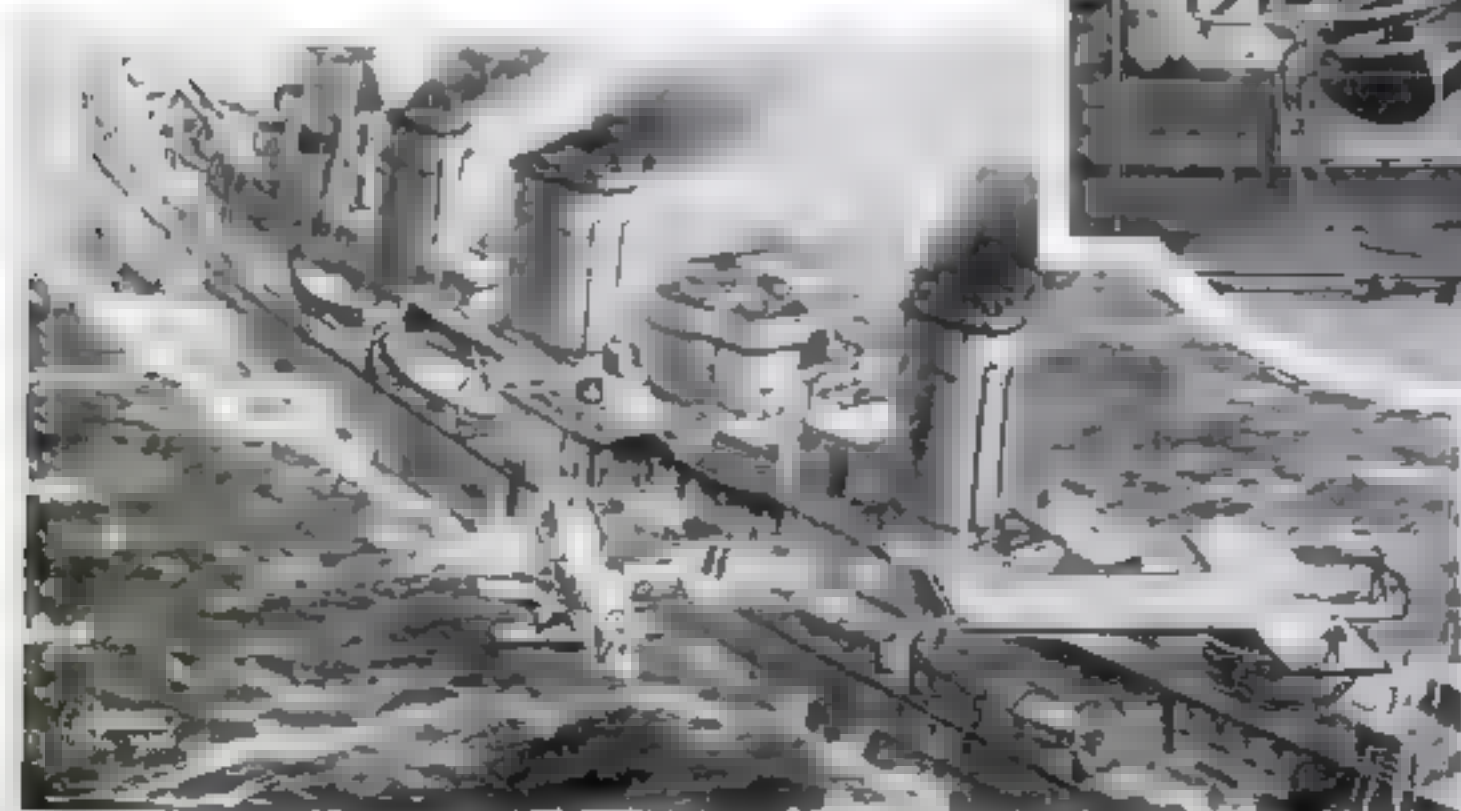
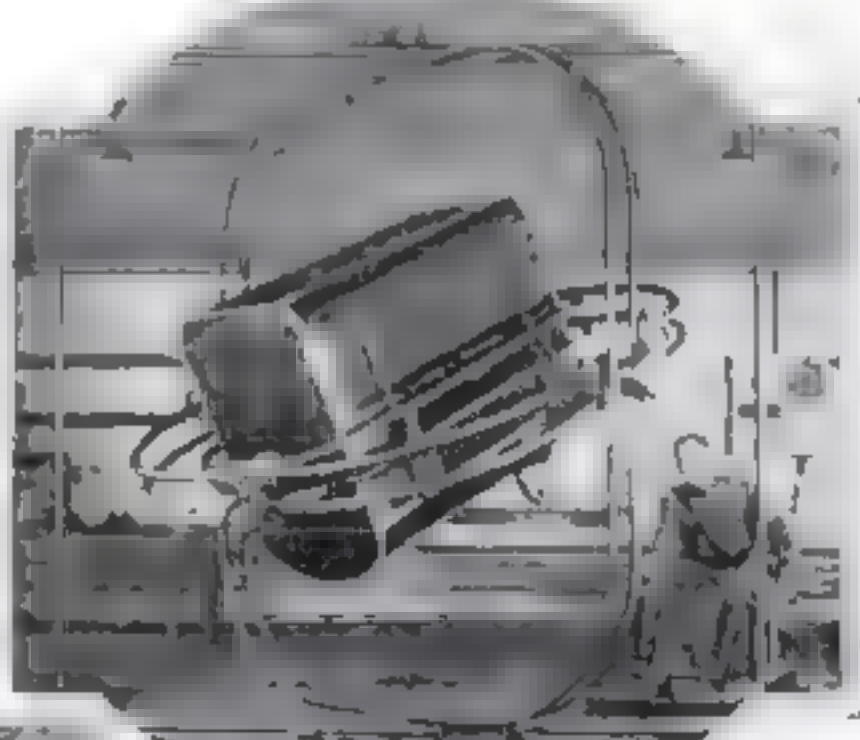
twelve-meter, twenty-five million cycle wave, which is not impossible, will serve the purpose, says Dr. Alexanderson—and the problem of television will be solved.



Radio photograph of a newspaper clipping, showing the quality of photography which it is hoped to get in motion picture transmission.

Without the benefit of any such high speed precision devices as Dr. Alexanderson's, hampered almost hopelessly by lack of funds, John L. Baird in London, England, has come close to practical television by methods all his own, and strange humming noises tell neighboring radio fans that moving pictures are speeding through the ether. For with sugar boxes as framework, and with an optical system of lenses from bicycle headlamps, Baird is said to have succeeded in sending by radio crude moving pictures of the animated dolls that he uses to test his apparatus. With only a few hundred, instead of many thousand, light dots on his screen, he has managed, it is reported, to make visible miles away the moving lips of a man talking and the smoke curling from his cigarette.

Aviation's Newest Conquests

[illegible]

Army air pilot candidates must pass grueling tests of balance and reflexes for three and a half hours in the simulator before they can take the actual flight. We tried acrobatics in every position to see how the bulk of the flying suit fit in and of a back brace. The ability of the officer at the right, they would have to be able to maintain an eight-foot position at the end of a given line. Here in the picture how the unique pivoting arrangement can give three different motions simultaneously.

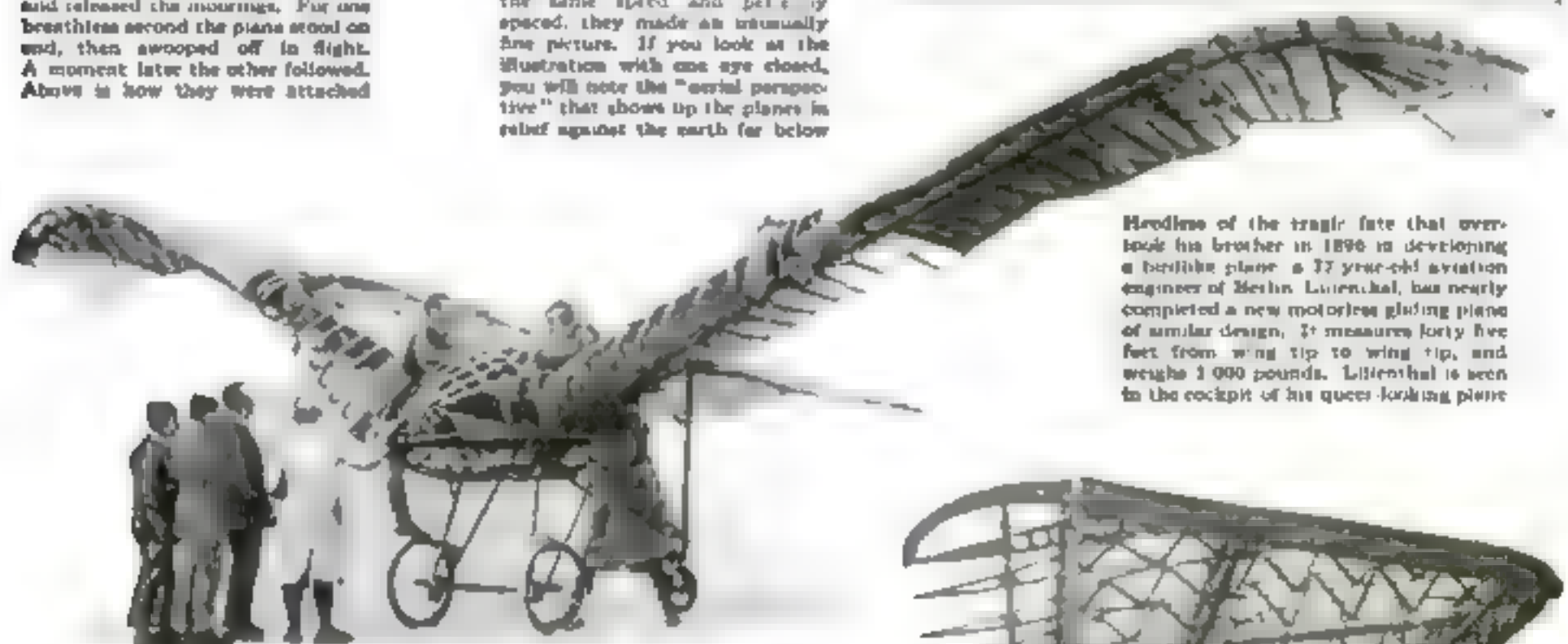
Novel rotating platforms that enable an airplane to "take-off" from the decks of a battle cruiser after a run of only a few feet give aerial eyes to England's latest warships, the *Enterprise* and the *Emerald*. The rotating and tilting features of the platforms make it possible for the pilot to take advantage of the prevailing wind when flying off. Pivoted on a circular base, the forty-foot platforms are swung to point directly into the wind, which is augmented by the speed of the ship. In the face of this blast of air, the plane need run only a short distance to reach its flying speed, as the wind's velocity is added to its own. Its motor is started, its restraining cable jerked away, and like a shot from a gun, as shown above, the firing boat zooms aloft.

the World Over



For the first time in history two fighting planes were launched up and up recently from a single air at Point Mugu. From a trap door in the R. 13's gas bag, an army officer dropped into the cockpit of one of the planes swung beneath, and released the mousings. For one breathless second the plane stood on end, then swooped off in flight. A moment later the other followed. Above is how they were attached.

Taken from a warth plane, this northeast photograph shows five U. S. naval machines flying in close formation over San Diego, California. Traveling exactly at the same speed and pace, they made an unusually fine picture. If you look at the illustration with one eye closed, you will note the "aerial perspective" that shows up the planes in relief against the earth far below.



Headline of the tragic fate that overtook his brother in 1896 in developing a biplane plane, a 37-year-old aviation engineer of Berlin, Lillenthal, has nearly completed a new motorless gliding plane of similar design. It measures forty-five feet from wing tip to wing tip, and weighs 1,000 pounds. Lillenthal is seen in the cockpit of his queer-looking plane.

Spanish aviators hope to make a new record for long-distance flying with a huge all-metal biplane the framework of which has just been completed at Madrid. The illustration shows with exceptional clearness the details of this modern type of construction, with its trim light alloy frame and cross members supplanting the bulkiness of wooden supports and braces. Designed primarily for military reconnaissance, the bomber has an aerial camera and a formidable machine gun attached to the fuselage.



How Much Shall I Pay

A complete outfit can be had for from \$61 up, but upkeep must be considered—Why good equipment is cheapest in end



Entertainment is what you are paying for when you buy a radio outfit, and the amount of pleasure you will derive from the equipment depends on the quality of the apparatus you get. Remember that the upkeep cost of the more costly set is not very much higher than that of a low priced set.

HOW much can I buy a radio set for? What will a complete outfit cost me? What is the difference between an expensive radio set and a cheap one? How much does it cost to run a radio receiver?"

Questions like these are received by POPULAR SCIENCE MONTHLY in a constant stream. It isn't easy to answer them because no two people have exactly the same requirements. And the subject is complicated still further by the wide differences in local conditions under which a radio receiver is called upon to give satisfactory service.

You can, however, easily figure out the minimum price at which you can get a complete radio outfit capable of adequate loudspeaker operation. Similarly, it is easy to compute the price and operating expense for various more pretentious radio receivers and the equipment that should be used with them for best average results.

You can solve your individual problems by making due allowances, one way or the other, from these average figures.

Taking the list of radio apparatus approved by the Popular Science Institute of Standards as a guide, we find that a complete radio outfit, including loudspeaker and all necessary accessories, can be bought for as little as \$61. This amount will buy a small four-tube set, four vacuum tubes of the dry cell type, three dry cells to be connected in series to act as an A-battery, two 45-volt dry cell B-batteries of the light medium weight type, a small horn loudspeaker, and antenna equipment. As far as first cost is concerned, this is the low limit.

Figuring the annual upkeep cost of such a set also is simple if you take average figures for the life of the various items that wear out or are used up.

In checking up the annual cost of any piece of machinery, such as for example, an automobile, the depreciation of the machine itself is important. You can arrive at the amount of depreciation by estimating the resale value of the car at the end of each year, or you can spread the original cost over the years that the machine lasts before wearing out.

Neither of these systems properly applies to radio receivers. Nobody can estimate the second-hand value of a radio set in the years to come, and radio sets do not wear out in the sense that automobiles do. Of course in time it may become obsolete in both appearance and electrical design, just as does everything else built by human hands—but a radio

bought today will be giving just as good results ten years from now, barring accidents.

Leaving out depreciation of the radio receiver, then, the low-priced set first mentioned will cost you approximately \$13 a year to run, if you use it an average of two hours a day. This amount pays for eight new sets of dry cells for the A-battery and two sets of B batteries, and it takes into consideration the fact that vacuum tubes last, on the average, about 1,000 hours.

THE annual expense for operating a set of this type can be reduced to \$22.75 if you are willing to increase the original cost to \$80.30, the extra money being invested in larger and more economical B batteries, a small four volt storage battery and a trickle charger.

The next step up in the scale of quality would be a five-tube radio receiver designed for use with storage battery tubes. Figuring on the same basis as before, the cheapest approved outfit you can buy comes to \$95.30. Judged on the basis of distance, selectivity and tone quality, this set would be a little better than the dry battery outfit mentioned above, and the volume would be greater. Its upkeep would cost about \$39.50 a year.

From this point on, an increase in the first cost of your outfit results in a corresponding improvement in tone quality, workmanship, operating characteristics and the appearance of the receiver. All of these are gained at slight increase in annual upkeep cost as long as you confine yourself to a five-tube set.

ASSUME for instance that you spend \$125 for the receiver and equip it with suitable accessories, including a cone type loudspeaker. The cost will then run to a little more than \$200 and the upkeep cost will be about \$41.20 a year. The increase over the cheapest five-tube storage battery outfit is caused by the extra B-batteries required and the power tube.

Spending \$150 to \$200 on the radio receiver alone and buying a thirty five-dollar loudspeaker would not increase the annual upkeep by so much as one penny, while the quality of your reception would be much improved.

Annual upkeep costs on radio outfits of all grades can be reduced materially by increasing the original investment to include a B-battery eliminator in place

Read the Important

EDITORIAL
ANNOUNCEMENT

on Page 2 of
This Issue

for a Radio Set?

By *Alfred P. Lane*

of the dry cell type B-batteries. High-grade B-eliminators are in a class with radio sets for durability. Suppose, for instance, that you increase the cost of the two-hundred-dollar outfit to about \$225 and buy a good B-eliminator. Your upkeep cost would drop to around \$30 a year or only a few dollars more than you would have to spend to keep in operation the cheapest set you could buy!

In all these estimates of the annual cost of operation, an average use of two hours a day has been assumed. The cost would, of course, be greater if the set is used more hours a day and less if you run it only one hour for instance. The cost is, however, not in direct proportion to the number of hours the set is used.

THE depreciation that must be charged off each year to allow for replacing the storage battery is almost constant regardless of the number of hours of use, although if a set were used an average of ten hours a day the battery would be worked so hard that it would probably give out before the four years were up.

Of course the B-batteries last longer if they are used less, but all types of dry cell batteries have what is known as a fairly definite "shelf life." In other words, they depreciate at a certain rate even when they are not used at all. You might find, therefore, that cutting down the use of your set to an hour a day might reduce your B-battery expense only by a quarter or a third.

An analysis of the relative operating cost of the various radio outfits mentioned above brings out some interesting facts. There are just three items on the operating cost list for the sixty-one dollar outfit. The tubes depreciate at the rate of about \$6 a year, the dry cell A-batteries will run to \$12, and replacements on the light medium weight B-batteries total up to \$13.

When you substitute a four-volt storage battery and a trickle charger for the dry cell A-batteries, you eliminate the replacement cost of the dry cell batteries and charge up depreciation on the storage battery plus expense for the current used by the trickle charger to keep the battery charged. About \$17.50 covers the yearly wear on the battery, and the current cost will probably amount to around \$4. Dry cell type tubes take little current, and the charger will have to be run only part of the time to keep the battery charged.

ON THE two-hundred-dollar outfit the annual expense cost is made up of the following items: tube wear, \$9; A-battery depreciation, \$2.50; B-

battery replacement, \$16.50; C-batteries, \$1.20; current for trickle charger, \$12. When you substitute a B-battery eliminator you cut out the B-battery replacement charge of \$16.50 and substitute \$4 to cover the cost of the current used to operate the B-eliminator.

While these costs loom large when you total them up on a yearly basis, they are almost insignificant when you compute them on an hourly basis and consider what you actually get for your money and compare the cost with almost any other form of entertainment.

On the basis of these figures you can enjoy a solid hour of music from some of our finest concert and dance orchestras

full quality results from the speaker. Similarly, it would be poor economy to buy a small, low-priced loudspeaker to go with a high-priced set—the speaker would severely handicap the quality possibilities of the set.

BECAUSE it does not wear out and have to be replaced, the receiver itself may be considered a permanent part of the installation. The same may be said of the loudspeaker if it is not abused. Tubes and batteries, on the other hand, wear out and just as fast in a lower-priced set as in a more expensive one.

Dry cell B-batteries have a useful life that can be estimated with fair accuracy.

Vacuum tubes are not so uniform. Like ordinary electric light bulbs, they may last for thousands of hours if you happen to be lucky, or they may burn out or go dead in a few hundred hours. One thousand hours is a fair average. Storage batteries have a reasonably well-defined life period. If cared for properly, any good storage battery, regardless of its size, will give fair service for four or five years, occasionally a battery will last even longer than that. In all of the above estimates of annual cost, the life of the storage battery has been figured at four years. Studying the annual upkeep figures for various grades of receivers brings out one point quite clearly which is this: The tubes that you wear out and the batteries that you use up, plus the electric light current required to keep your battery charged, cost equally as much whether the receiver which you have is a low-priced or a more expensive one.

IT IS interesting, therefore, to consider the relation between the cost of the bare receiver and the accessories that you are compelled to buy in order to put it into service. In buying a low-priced set, you are spending a large proportion of your total outlay on equipment. In the case of the first two low-priced outfits mentioned, the price of the set amounted to approximately thirty-five percent of the total, whereas sixty percent of the total went into the receiver in the two-hundred-dollar outfit.

It would seem to be the wise course, therefore, to stretch the pocketbook a bit and spend the extra money on the set and the loudspeaker, since these two items are responsible for the quality of the results you obtain.

You will have to be the judge of what kind of an outfit will prove satisfactory. All that the Popular Science Institute of Standards can do is to make sure that you will get good value for your money if you buy according to the approved list.



To Help You Choose
SEND for the list of radio receivers and accessories approved by the Popular Science Institute of Standards and use it as your purchasing guide. It will help you choose the apparatus best suited to your needs. Address: Radio Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Ave., New York City

at a cost of from three to five cents! Contrast that with the cost of two hours at the local movie show or any other kind of entertainment for which admission is charged and you will have a fair idea of the small cost of radio entertainment.

It is possible, of course, to vary the type of equipment you buy for your set within very wide limits. However, the purchase of an expensive loudspeaker for use with a low-priced set would be a waste of money in most cases, because the set will not show it to get



The engineers of Popular Science Institute of Standards have worked out a remarkable new way of testing radio receivers for tone quality. Nothing is left to guesswork; all measurements are taken directly from meters. Part of the apparatus used in the test is shown in the above illustration. In the near future an article in POPULAR SCIENCE MONTHLY will describe the amazing results of these tests.

Hints for Radio Beginners

If Your Radio Tubes Howl—

Damper Caps Are Effective Remedies—Other Useful Ideas

THE more tubes there are in a radio set, the greater the chance for trouble due to various kinds of howls and squeals. Most irritating of these is the moaning howl caused when air vibrations from the loudspeaker strike back at the tubes in the radio set. The glass tube is set into vibration in time with the air waves, and the trembling of the tube shakes the elements inside the tube. As a result, electrical vibrations are set up to reinforce the original squeal until it becomes a terrific howl.

Anything that will act as a damper and prevent the glass of the tube from taking up such vibrations will cure this howl. A lead cap resting on top of the tube will stop the vibrations. If you haven't facilities to mold lead caps to fit the tops of your tubes, the same result can be attained by cutting a cross out of heavy sheet lead and bending the ends of the cross down around the sides of the tube.

Use Care in Sawing Panels

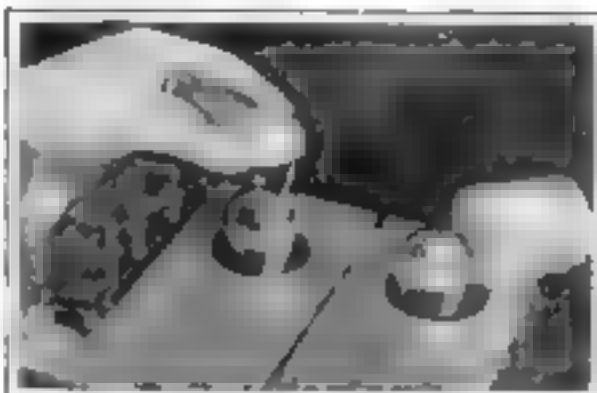
IN YOUR radio experimenting, you probably often have occasion to use a piece of bakelite or hard rubber of smaller size than standard. Odd shaped pieces can be cut from an old panel by the use of an ordinary hack saw, as panel material is relatively easy to cut. Clamp the panel in the bench vise with several layers of paper on each side to prevent scratches, and work the saw back and forth, using care to avoid biting in too deeply. It is easy to cut straight through a seven-inch panel even if the hack saw has only a three-inch clearance between the blade and the frame. Start the cut as shown in the illustration below and gradually swing the handle of the saw downward until the end of the cut is taken with the saw almost parallel to the panel.

The Correct Charging Rate

WITH the increasing popularity of trickle chargers for charging radio storage A-batteries has come the question: What would happen to the battery if, for instance, the receiver is not used for several days and the trickle charger is left operating at the usual half ampere rate?

No harm will be done to the battery under such conditions. A storage battery of not less than thirty ampere hour capacity can be charged continuously at a half ampere rate without damage to the battery even if the charge is kept up for long periods after the battery has attained a state of full charge. The extra current slowly decomposes the water in the battery solution.

In fact, the only harm that can be done to any battery by excessive charging is to heat it up and dislodge the active material from the plates through exces-



Lead caps will kill vibration in the glass of your vacuum tubes and stop them from howling

A B C's of Radio

MANY readers seem to feel that the new power tubes give more volume without distortion on all signals, both weak and strong. This is not true for weak signals. In fact, on extremely weak signals from distant stations, the ordinary 20A type tube will give a trifle louder results than the 171 power tube. But the minute you begin to bring in signals with any degree of volume, the advantage of the power tube shows up at once. As the strength of the incoming signal is increased, a point is soon reached where the ordinary 20A is overloaded and distorts badly.

For maximum results with any type of power tube, always operate it at the highest B and C voltages recommended by the manufacturer. The 171 tube will give you the most volume with the least distortion on loud signals, but the 112 tube will be better on weak signals because it amplifies a bit more, although it will not handle as much volume as the 171 tube.



A seven-inch panel can be cut straight through with an ordinary hack saw by sawing on an angle so that the blade is nearly parallel to the panel

sive gassing. However, these deleterious effects are produced only when the charging rate is relatively high; a prolonged charge at a five to ten ampere rate sent through an eighty ampere hour battery would eventually cause trouble.

On the other hand, thousands of radio batteries suffer from premature old age because they are not charged often enough and long enough. All storage batteries end up in the scrap pile at the end of five or six years at the most, but constant undercharging will turn them into junk in a year or two.

The safest policy, therefore, is to keep your battery filled with distilled water at all times and give it more charging than it actually needs.

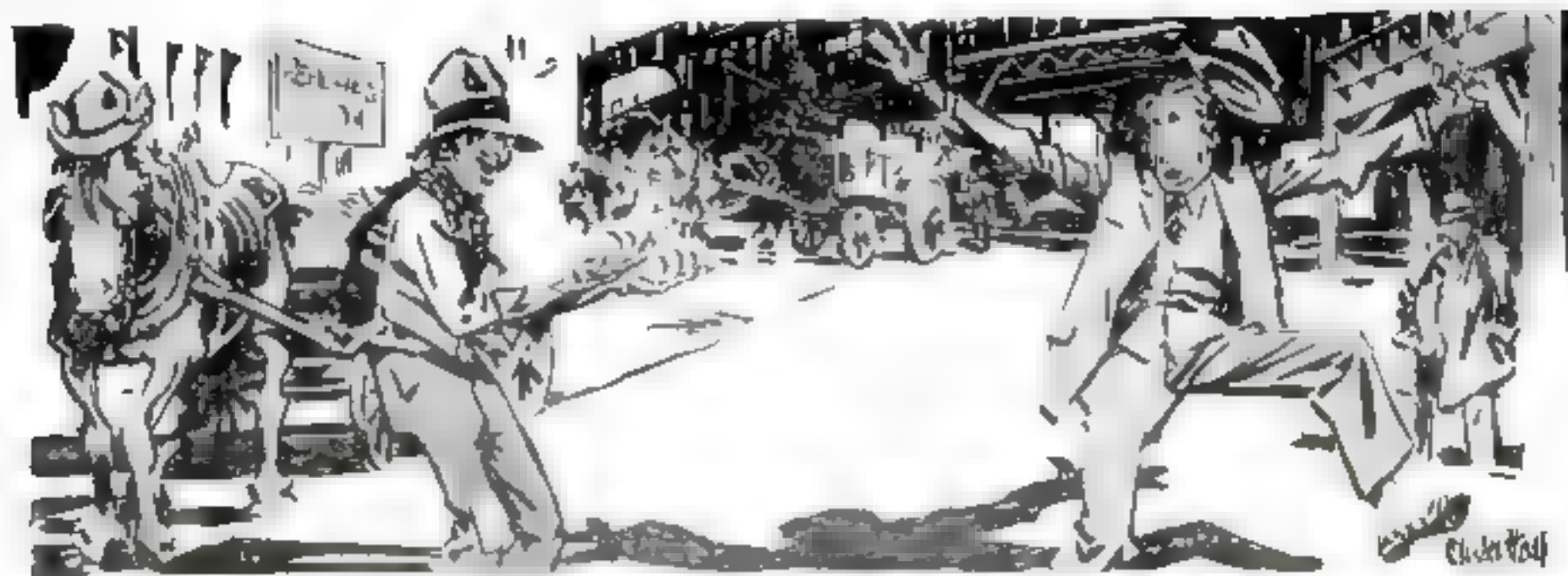
Connect the Radio Set First

CABLED connections for the radio battery leads are excellent. In fact, a number of factory built sets are regularly equipped with them. If, however, you have a set that is fitted with binding posts and you want to use a battery cable, be sure to connect the wires to the binding posts of the set before you connect the other end of the cable to the batteries. By doing the job in this way, you will avoid a chance of a short circuit that may burn up the wires or discharge the B-battery. In fact, it is best to connect the battery last and disconnect it first no matter what kind of wire you use.

"What Size Wire Shall I Use?"

IN WINDING radio coils, the radio beginner often is puzzled as to how to proceed if he doesn't happen to have wire of exactly the specified size on hand with which to wind the tuning units. There is no magic in wire sizes within rather wide limits. If the specifications for a given coil call for No. 22 double silk covered wire and you haven't that size on hand, use the nearest size to it. Of course, if you use different wire you will have to change the number of turns to get exactly the same results. Suppose No. 22 double silk covered wire is specified. If you use cotton covered wire of the same size, a few more turns will be required to get the same results. If it is single silk covered wire, less wire will be needed because of the closer spacing of the turns. Larger wire requires more turns and smaller wire fewer turns.

The diameter of a coil also can be changed if you find it necessary. Reducing the diameter will require more turns of wire and increasing it will allow you to cut down the number of turns. Bearing these facts in mind will help you to adjust your coils to the required wave length. The lower the wave lengths you desire to cover the fewer turns of wire needed.



The thought of peaches makes some otherwise perfectly normal people behave quite strangely!

Why Some of Us Can't Stand Cats

Your Pet Aversions Explained by Recent Discoveries

By PETER VISCHER

THAT one man's meat is another man's poison is more than a proverb. It's an age-old mystery to which medical science is only just finding the key.

This mystery involves the eerie world of idiosyncrasies, in which persons grow violently ill at the passing of a horse, or, as in the case of the late Lord Roberts, become intensely disturbed at the presence of a cat. It is a world in which persons feel positive discomforts at the sight of certain colors or the subtle diffusion of curious smells.

Who of us does not know someone who cannot eat eggs, or crabs, or oysters, lobsters, almonds, onions, tomatoes, cucumbers, strawberries, fish, honey, or milk, without becoming instantly ill? Every doctor knows of patients who have an unconquerable aversion to certain drugs or chemicals, such as quinine, morphine, potassium iodide. Others cannot breathe wood dust, or pollen from certain flowers and grasses.

Recent investigations have given us a new insight into these peculiar reactions, and scientists have succeeded in making sufferers temporarily immune to some of them besides conceiving an amazing theory to account for the phenomena. The theory is as follows:

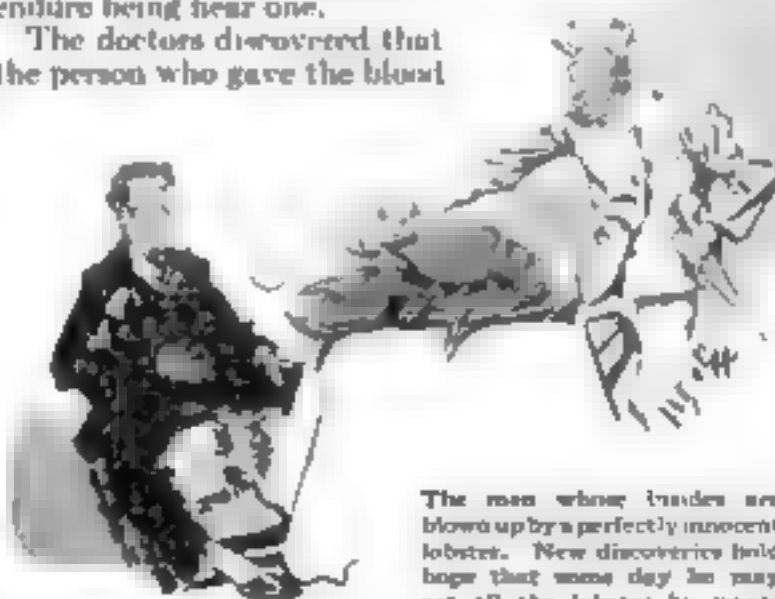
LITTLE specks of chemical dynamite called "antibodies" are present in the bodies of many people, particularly nervous persons. There are different kinds of antibodies, and each has its specific "antigen," or poison. Fish may be an antigen for one kind of antibody; the smell of horses for another. Whatever the cause, when the antigen is introduced into the body it behaves like a fuse cap and sets off the dynamitelike chemicals in the antibody—and the unfortunate person whose stomach is being made into a chemical laboratory suffers acutely.

At one time scientists imagined that the individuals who were susceptible to cer-

tain foods were, perhaps, naturally weak and the foods poisoned them in some simple, direct way. Then a case occurred that completely upset their beliefs and indicated that one man's pet aversions could be transferred to another.

A cab driver was injured in an accident and a blood transfusion was necessary to save his life. When he left the hospital and climbed into his old seat on the cab, he discovered to his chagrin that though he had spent all his life driving horses, he could no longer endure being near one.

The doctors discovered that the person who gave the blood



The man whose blood was blown up by a perfectly innocent lobster. New discoveries hold hope that some day he may eat all the lobster he wants.

necessary to save the cabman's life had a profound aversion to horses. The obvious conclusion was, the idiosyncrasy had been transferred in the transfusion. Then, after three months, the hackman's acquired idiosyncrasy disappeared.

But where did the peculiar antibodies come from, the doctors wanted to know next? Were they hereditary? Was a man made ill by eating strawberries because his father was?

Two French investigators, Widal of the University of Paris and Beardedka of the

Pasteur Institute, at once commenced a series of experiments on guinea pigs, rabbits and ~~birds~~ injecting irritating substances from other animals, to see if they could produce antibodies artificially. Success rewarded them. Inoculated with the serum the animals became abnormally sensitive, their skin itched and their hair stood erect, while several died from suffocation. Examination showed that death was caused by a violent tightening of the breathing tubes, which prevented the air in the lungs from being exhaled. Striking conclusions were drawn from these tests.

Now, scientists said, the existence of antibodies had been demonstrated, and idiosyncrasy has been proved to have its own antibody, and the antibodies themselves had been discovered to have their place of birth in certain cells of the connective tissue of the body.

THIS was accepted as the explanation of all our idiosyncrasies, whether it be crabs or quinine, honey or sawdust that makes our tongue and throat swell or interferes with our breathing.

Oddly enough these symptoms are strikingly similar, no matter what the particular idiosyncrasy may be. This strongly favors the belief that the antibodies are responsible. It is their explosive reaction with their antigens, not either substance by itself, that gives you headache or nausea.

If asthma or hay fever troubles you, it is probably due to a sensitiveness to certain dusts that cause the birth of antibodies, and in some instances the specific "dust antigen" has been tracked to its lair and caught. (Continued on page 168)

Thirteen Years Old—a

IF I had my life to live over again from the age of thirteen onward, I think I'd rather be in the boots of young David Putnam than those of any other boy in the world.

David isn't the son of a millionaire, and he hasn't any unique talents. He is just about like any other awkward, happy, healthy, growing boy in his 'teens. But one grand and glorious thing has entered David's life. This thing is David's love and understanding of the world about him—coupled with extraordinary opportunities to exercise this love.

Very likely you have heard of this boy, the son of a New York publisher. Only thirteen years old, he has visited more unusual corners of the earth and has had more strange experiences than fall to the lot of most of us in a lifetime.

He has cruised the South Seas and has stepped upon the shores of desolate islands, once the haunts of pirates, inhabited by huge reptiles. He has sailed among towering icebergs of the Polar Sea. He has hunted polar bears, made friends with Eskimos, and watched the narwhal, walrus and seal in their native haunts. He has experienced the thrill of seeing a big volcano break into eruption. His whole young life has been crowded with these and other adventures, equally fascinating.

WHEN William Beebe, the explorer-scientist of the New York Zoological Society, sailed on his famous voyage of discovery to the desolate Galapagos Islands off the coast of Ecuador, South America, young David was one of the party aboard the exploring ship *Arcturus*. Again, when the schooner *Morrissy* of the American Museum Greenland Expedition pushed into the frozen North last summer, David went along.

And, as if this were not enough for one energetic youngster, David is the author of two widely sold books, and is better known than any other American boy save, perhaps, Jackie Coogan.

What has he gained from it all—in fun and profit? His experiences, which any real boy might well envy—have they really been worth while? And just what kind of a boy is this? To find the answers, I went to see David the other day.

I found him in his room—a veritable museum lined with curious trophies of his expeditions. Within its four walls were packed the lure of remote places and the romance of the sea. Even his bed recalled the pitch and roll of the foaming waves, for it consisted of a double-decked bunk of the kind found only on

His World a Wonderland

A VETERAN of scientific expeditions in the Tropics and in the Arctic. Explorer of strange corners of the earth. Author of successful books. And yet an average, awkward, happy, growing boy of thirteen! That is David Binney Putnam, about whom Commander Green of the U. S. Navy, himself a noted explorer, has written on these pages.



by

Fitzhugh Green

shipboard. As I glanced about the room, I saw that everything was being done to stimulate his intense interest in Nature and his love for the out-of-doors.

"How did it all start, David?" I asked.

He grinned a wide, boy-sort of grin and replied:

"Ever since I can remember, I guess. I was born in Bend, Oregon, in a high country where there used to be volcanoes and lots of lava flows. Out there rocks float, real rocks, made up of what is called pumice stone, which is lighter than wool. It was finding out about queer things like

that, I guess, that got me interested.

"It's a great salmon country, too. Salmon are queer fish. The parents go upstream and lay their eggs and then die. The young fish, after they are born, go out of the stream and disappear into the ocean, I think it is for four years, in the fourth year they come back to exactly the same stream where they were born.

"SCIENTISTS found that out by tagging some of the fish. How they find their way back to their native stream after all that time is a mystery. Isn't that pretty interesting?"

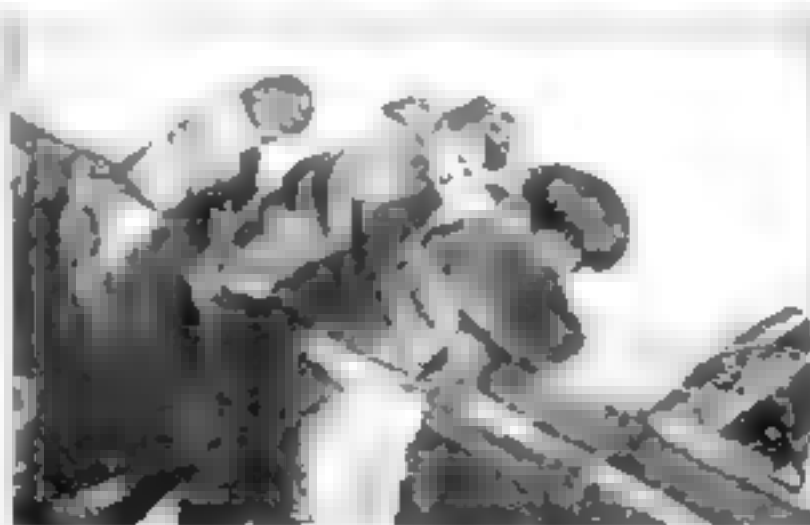
I agreed that it was. Then I got the lad started on his experiences among the pirate islands of the tropics. For all his "grown-up" way of talking, he had a freshness of viewpoint and enthusiasm that would make real grown-ups talk a lot more interesting. His eyes glinted as he talked. He spoke of sea lions and sharks and whales until I was as tired as he.

"As a matter of fact," he went on, "in the tropics are plenty of birds that swim as well as fish that fly. There are even some birds that neither swim nor fly. For instance, the flightless cormorants on the Galapagos have

lived for such a long time on an isolated island where they had no enemies and where they didn't have to fly to get food, that they have lost the use of their wings.

"My friend, Mr. Beebe, who invited me on the *Arcturus* trip, found a whole new series of fish life. Many of the new fish had electric lights. That sounds queer, but it's true. They have feelers sticking out in front of their heads, with little shining lights on the ends of them. This helps them get around in the dark depths, and it also attracts little creatures which the owner of the light then eats up. That is the firefly's use of his sparkler, too."

I ASKED David what I gave him the biggest "kick" on that cruise. "The greatest thing we saw on the Galapagos Islands," he came back quickly, "was the outbreak of a big volcano. Lava boiled right up out of the crater and flowed down into the sea. It was a wonderful sight, but pretty awful to watch. The hot molten rock slid like a great stream of red



The Eskimo children, shown with David Putnam, are chewing walrus windpipe, used by the natives instead of chewing gum. (In oval, above) Young David being taught to eat narwhal skin

Veteran Explorer!

Curious People, Birds, Fish and Animals Seen by An Amazing Boy

molasses candy down the mountain. When it reached the sea, the water boiled and great clouds of steam rose up. The temperature of the water close to shore where we eased in with the *Arcturion* got as high as one hundred degrees.

"A HUGE sea lion boiled to death under our eyes. He got into the hot water, became confused and couldn't find his way out again. The poor thing jumped into the air in agony two or three times before it died."

We chatted about David's cruise last summer up into the Arctic, where he learned a great many more interesting facts most people don't know. For instance, the average person thinks icebergs must be salty. But David reminded me they are not. As a matter of fact, the pools of ice water on the bergs are quite fresh. The expedition vessel went along side bergs and got fresh water out of the pools for its tanks. The reason for this is that bergs break off from glaciers, and glaciers are made from snow.

"Another thing that struck me right off the bat," my young naturalist rattled on, "was the popping of the big icebergs, like a repeating rifle being shot close at hand. I learned from one of our scientists that this was the pressure of winter shrinkage being released by the warm air of the summer."

"HOW did you like the Eskimos, David?" I asked. I could tell by the expression that came into his sunburned face that he liked them.

"We saw a good deal of the natives," he said. "The Eskimo eats nothing but meat all his life—what do you know about that? One of his favorite dishes is clams out of a walrus' stomach, and he boils up the walrus' whiskers to make a sort of macaroni. I nearly got sick when I saw children eating walrus' eyes as if they were gumdrops, and chewing walrus' windpipe, which makes good native chewing gum. Say, I wouldn't have believed it if I hadn't seen it with my own eyes!"

He spoke about Eskimo clothing. From what he said, it was clear that

Cleaning the head of an Arctic narwhal, under the direction of Harry Raven, ecologist. This whalelike creature grows twenty feet long and has one huge tusk.



People who don't notice the birds about them don't know the fun they're missing, says David. This pet penguin, one of the smaller creatures found on the *Arcturion* trip, taught him many curious things about flightless birds.

a native of the North certainly knows how to keep warm. One of them had told the boy that a tired man gets a cramp, and that you never see a native with his arms stretched out and his legs apart. Such a posture would uncover the big blood vessels. The Eskimo keeps his wrists, knees, and forehead well covered, keeps his feet dry, and lets his clothing hang loose and the air circulate up his back, thus preventing perspiration from wetting his shirt.

"THERE weren't any trees in North Greenland," observed David. "The tree line seems to stop somewhere down in northern Canada. Down at Godhavn on the western coast they told us a sort of lads which grow under the snow in the coldest weather in the winter. A hot spring bubbles up in the ground and forms an arch of snow over the heads of the flowers. You wouldn't think flowers would bloom down on the shores of the Polar Sea, would you? But nearly two dozen varieties grow in North Greenland every summer, when the temperature gets above freezing for a few weeks."

"I'll tell you another funny thing. All my life I've been hearing a lot about Indians' finding their way around by instinct. I was talking to Dr. Rasmussen about this." (Dr. Knud Rasmussen, noted Danish explorer, was one of David's shipmates in the *Marianne*.) "He said he didn't believe there was any such instinct. It is just a case of an Eskimo or Indian, early in his life, getting the habit of noticing things that he passes—a black rock, a break in the hull, a fox hole. Without realizing it, he puts these things down in his mind. Later when he comes back, he can pick up the trail he passed over before. He really sees things without seeing them."

From what David told me, I gathered that the habits of (Continued on page 103)



David Putnam, of Rye, N. Y., who at thirteen has participated in two scientific expeditions and is the author of two widely sold books. Here he is in his Arctic outfit.

New Ways Science Is Serving Us

Rubber Plated Articles, Colored Steel, Cure for Insomnia, Paper from Cornstalks, and Other Marvels Promised

On these pages are presented each month brief stories of scientific discovery and research having practical bearing on our everyday problems.

Rubber Plated Goods Now Being Made

BEFORE long you may be wearing rubberplated overshoes and your car may be shod with rubber plated tires!

From Akron, O., comes the announcement that experts are predicting revolutionary changes in the rubber industry through the application of a newly developed process of manufacture which resembles in principle the electroplating of metals.

This process is the outcome of experiments in pure research by Dr. S. E. Sheppard of the Eastman Kodak laboratories. Using an electrolytic solution containing extremely minute particles of rubber, he found a way of depositing rubber on the anode of an electric circuit. In the commercial application, the anode serves as a mold or form on which the rubber is deposited. Manufacturing experts say it is possible to rubber plate molds of any shape with rubber as thin as tissue paper or as thick as a brick wall.

Silken thin tobacco pouches, gloves, bathing caps, and hot water bottles, made by the new process, are said to possess more strength and resiliency than ever was possible before.

Sees Gasoline Pink but Plentiful

THAT the motorist of the future will have to expect gasoline of all colors and odors when he fills his tank, is a probability seen by Dr. Gustav Egloff, of Chicago, who has investigated the possibility of getting motor fuels from various sources.

"Not only should the public get used to all sorts of colors in gasoline, but to all sorts of odors as well," Dr. Egloff says. "The modern 'cracking' process is responsible for these new characteristics, but the motor will operate as well with the yellow as with the water-white, blue, pink or even red gasoline.

"The potential future gasoline supply will last for hundreds of years, and it will come from 'cracking' a wide variety of materials such as petroleum, coal tars, shale oil and wood tars. The old-fashioned gasoline was simply evaporated off the crude oil and had no antiknock prop-



Insomnia sufferers are hopeful in the sleep-producing apparatus of H. E. Guilleminot, of Paris. The patient above went to sleep in eight minutes! A black band over the eyes, containing a tiny blue electric bulb, and a small electric vibrator are the features of the apparatus.

ties. The modern 'cracking' process is a way by which heavy oils are chemically broken down into lighter oils having valuable antiknock properties. The future gasoline will be a mixture of the two and yield double the mileage."

Our Longer-Lived Dollars

HEREAFTER a dollar bill will last just twice as long as it used to. You can take the word of Uncle Sam's Bureau of Standards for this; for the Bureau, after experimenting for a year, has developed a crisp new greenback that will stay crisp and new long after its old-fashioned predecessors have been worn out by usage.

The secret of a new paper making process for putting double strength into paper currency lies in the addition of glue. The surfaces of the printed bills are given a coat of glue-formaldehyde sizing which not only improves their appearance, but also increases the resistance of the greenbacks to wear and soiling.

New Wonders of Invisible Light

THOSE mysterious rays of invisible light which constantly play about us, yet which we never see, hold seemingly endless possibilities for usefulness. For example, the latest use for ultra-violet rays is in the testing of silkworms. Healthy worms have the strange property of giving off visible light when exposed to invisible ultra-violet rays, whereas unhealthy worms give off weak light or no

light at all. Similarly, some dentists now use ultra-violet rays to determine whether teeth are alive or dead.

Even more alluring in their possibilities are the mysterious cosmic rays, first detected by Dr. Robert A. Millikan of the California Institute of Technology on the tops of the California mountains. Dr. Gerhard Hoffmann of the University of Koenigsberg, Germany, now announces that he has been able to detect at sea level the same cosmic rays



While the French experimenters of the upper picture have been combating insomnia, American scientists have been seeking a cure for sleeping sickness. Miss A. C. Evans, above, of the U. S. Public Health Service, is developing a serum to combat this dreaded disease—the picture shows her examining one of her culture tubes. Already her serum is said to have cured four cases.

Dr. Millikan discovered on the hilltops. The cosmic rays are extremely short and invisible light waves. They will penetrate six feet of lead, and still greater thicknesses of other materials. Some day we may learn how the cosmic rays affect us, and may turn them, also, to our needs.

Woman Finds Way to Color Steel

MANY of the fittings and ornaments about our houses, instead of being of brass, copper, silver or gold plate, may hereafter be made of attractively colored steel, now that a woman engineer of Birmingham, England, Miss C. Griff, has

found a secret process of coloring said to make the manufacture of colored steel ornaments commercially practicable.

The colored steel is reported to be stainless and rustproof. It will be used, among other things, for buttons, buckles and other personal ornaments, furniture and door trimmings. Not only can it be manufactured to look similar to the more costly metals, but the color can be applied in artistic designs.

Modern Franklin to Use Rocket

WHAT starts a lightning flash, and what determines the path of a lightning bolt through the atmosphere?

A modern disciple of Benjamin Franklin, Dr. C. V. Boys, British physicist, proposes to answer these questions by shooting a rocket up into a

whether a lightning flash will follow the track of the rocket either downwards to the earth or upward from the earth to the cloud.

Dr. Ilyin explains that the tank of a rocket contains countless electrified atoms which are discharged as the explosive drives

on the Mediterranean air routes. Experts estimate that the power it will draw from the winds will exceed the power which is generated by the huge plants at Niagara Falls.

Strange Medical Uses for Dyes

A STRANGE new aid in surgical operations now comes into the hands of physicians. It is dyes. Medical investigators, in recent experiments, have found that certain aniline dyes provide antiseptics said to be even more effective than the familiar iodine, and may be used even for the treatment of blood poisoning.

group of five aniline dyes which "justify hope of important discoveries." The others are brilliant green, acriflavine, mercurochrome and acriviolet.

Infected knee joints, he declared, have been sterilized with gentian violet, which has also proved effective in freeing from infection stumps of amputated limbs.

Sees "Sun Engines" Bottling Heat

"BOTTLED sunshine" transported from the tropics to light and heat the homes of those of us who live in colder regions is no idle dream but a scientific possibility, according to a recent report read before the Association of German

...in session at Berlin. By means of huge sun engines along the Nile, the Germans believe, water can be converted into hydrogen, which could be transported to any part of the world in quartz bottles and later burned for light and heat. That the earth's interior heat eventually will be harnessed for our use, was also predicted by the chemists.

Ocean a Vast Pasture Land

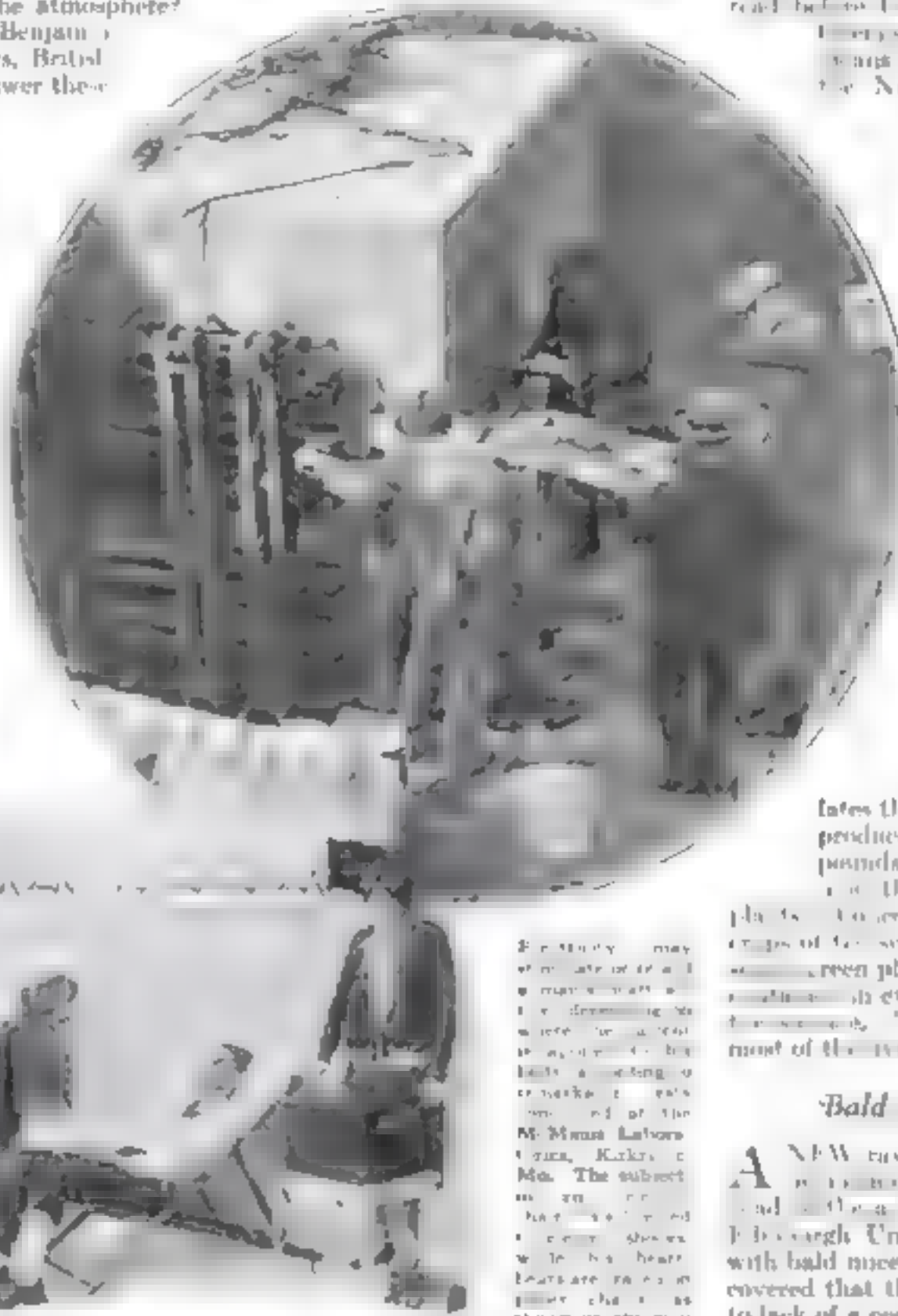
THAT the open sea has a waterery "farms" as vast and fertile as any to be found on land, is the conclusion of Dr. W. R. C. Atkins, after an extensive study of ocean-grown plants in the English Channel.

Dr. Atkins calculates that the Channel every year produces the equivalent of 12,000 pounds of plant life an acre, or more than the yields of many crop plants raised from cultivated soil. The crops of the sea consist mostly of microscopic green plants, millions of which are contained in every cubic foot of water at the surface. They supply the food for most of the living creatures of the sea.

Bald Mice and Men

A NEW ray of hope for bald-headed men comes from Dr. F. A. E. Crew, of the Glasgow School of Medicine, Glasgow, Scotland, from a small breeding institute of Edinburgh University. In experiments with bald mice, Dr. Crew reports, he discovered that the shedding of hair is due to lack of a certain gland substance. By extracting this substance from normal mice and transferring it to the bald ones, he claims to have grown new tufts of hair. Now he is at work to find out whether human baldness may not be due to the same glandular deficiency and curable in the same way.

PAPER is being commercially manufactured from cornstarch at a paper mill in Tama, Iowa. Prof. O. R. Sweeney of Iowa State College, who developed the process, predicts that eventually most of the newsprint of the country will be supplied by the by-products of the corn belt.



the rocket upward. Knowledge of whether lightning would follow such an electrified channel through the air, he says, might reveal many unknown facts about the nature of thunderbolts.

Huge Beacon to Top Mount Etna

WINDS which sweep the magnificent summit of Mount Etna, Sicily, are to be harnessed to light one of the world's most powerful beacons, a million candlepower light which will guide flyers

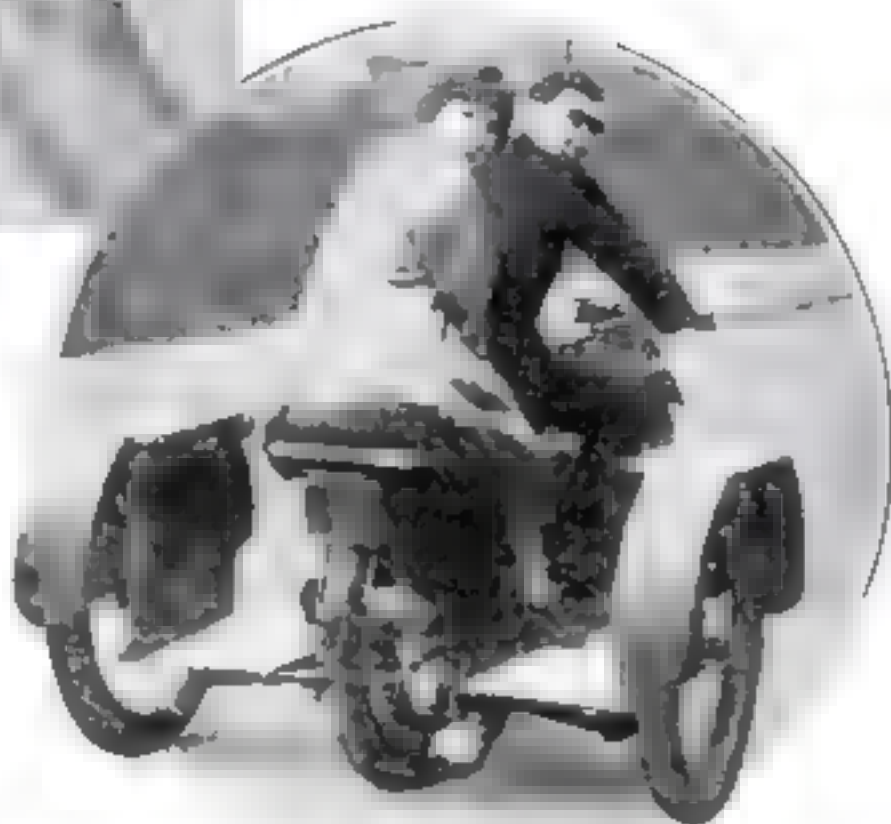
Two physicians of Ithaca, N. Y., Drs. Martin B. Tinker and Henry B. Sutton, declared in a recent report to the American Medical Association that some of the aniline dyes are almost 100 percent efficient in sterilizing the skin of a patient for an operation.

In another report, Dr. John W. Churchman, professor of experimental therapeutics in Cornell Medical School, New York City, showed the progress of experiments with dyes in treating blood poisoning. Gentian violet, he said, is one of a

Practical Novelties



Something new in cigarette holders is this ingenious device, which has a pointed prong in its end on which the cigarette is firmly pushed. It takes cigarettes of any shape, round or oval, and there is no waste end. You push the cigarette, light up, and it stays where it belongs until you are through smoking.



Auto with Motor in Pontoon Side Car, "Human Duck" And Other

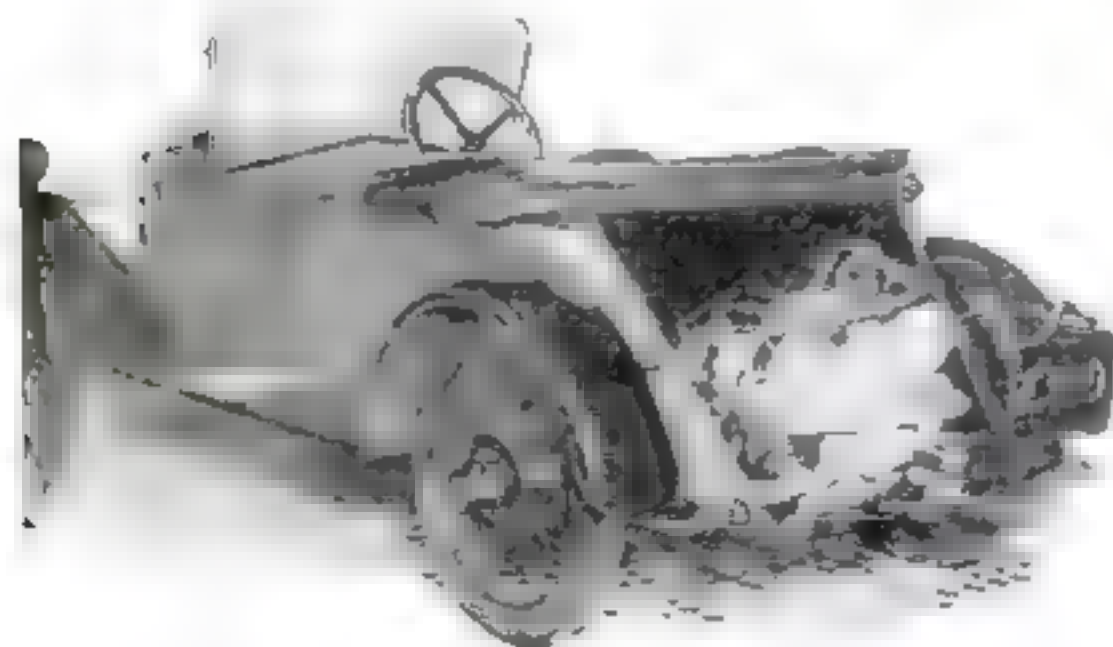


Passengers on trans-Atlantic liners have a new deck game—"boule"—combining tennis and marksmanship. Players compete on adjoining bull's-eyes, serving the ball at the bull's-eye. The accuracy of the shot determines the points scored. After each shot, the ball rolls back on a runway for a second shot. The striking ends when the ball is missed.

Three wheels in back and one in front—and you have two guesses to say whether this odd vehicle, above, is a motorcycle or an auto? Cycle handlebars steer it, while the triple wheels behind are designed to keep it in a vertical position when turning, and to prevent skidding. It recently appeared on the streets of London.



Letter boxes on trolley cars are the latest idea for speeding up mail delivery in Germany. Where the trolley line passes the main post office or railroad station branch, the innovation is a distinct time saver, saving many a trip to the post office.



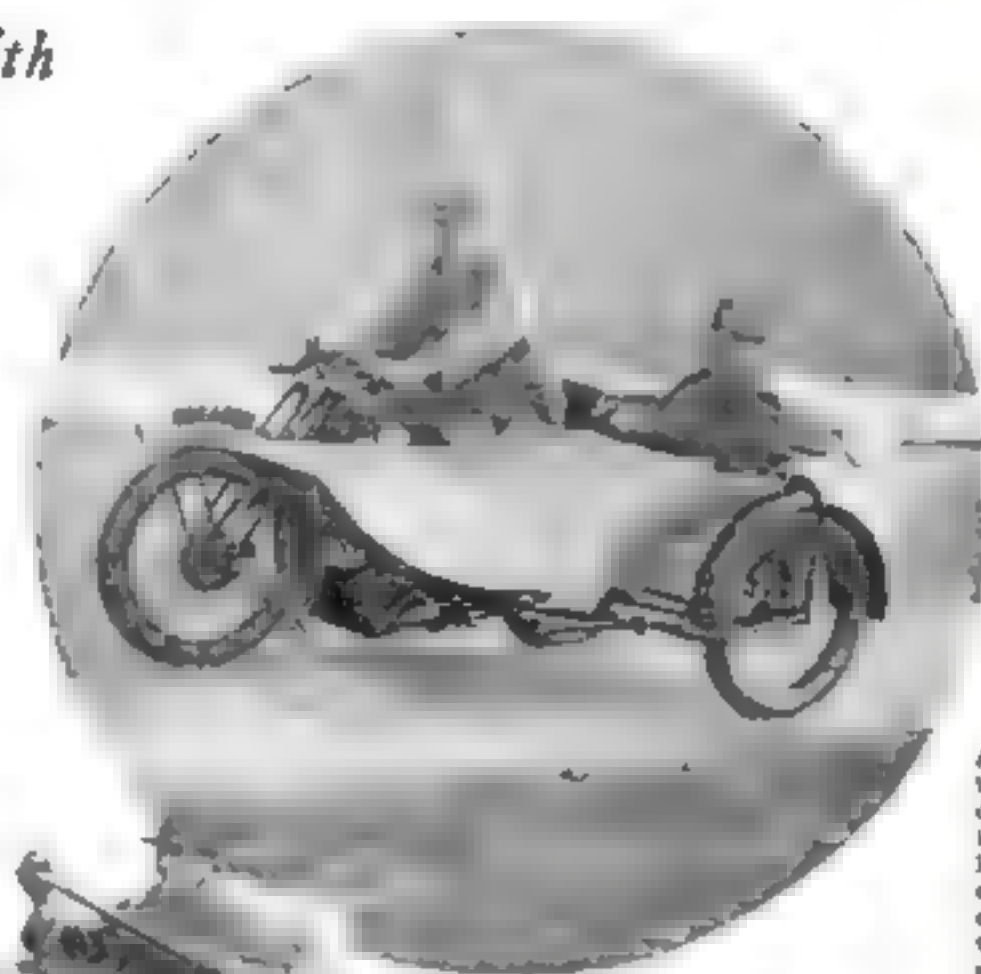
Closed, this device resembles an ordinary measuring pencil, even to the pocket clip on its graduated shaft; open, it becomes a handy twelve-inch steel ruler.

When you have to crank this machine, you seize the crank handle, step out the door—and go around to the rear. For the British manufacturer of this little car has concealed the motor at the back. Among the advantages claimed for the arrangement are more leg room in front, reduction of noise, greater accessibility of motor, and less likelihood of skidding, owing to redistribution of weight. The conventional body lines at the front have not been changed.

Devised by Ingenious Folk

Rear, Motorcycle with Foot-Rule Pencil, Swimming Outfit, New Devices

Adventuring across country takes on new possibilities when you can travel in a motorcycle that makes you master of land and water. This British cycle is equipped with a novel side car which, unhitched from its place, becomes a boat to navigate a river or a lake. When two motorcycles are travel together, they have the additional advantage of being able to lock their side cars together like a pontoon and so ferry their motorcycles across when they come to rivers. With these amphibious cycles two adventurers, Capt. George Mallory and Charles Oliver, have started out around the world.



A novel swimming aid for beginners, the outfit above is designed to prevent swallowing water and to insure regular air supply. It consists of a bathing cap equipped with a tube for admitting air to the mouth of the wearer and an exit for exhaled air through two lightweight tanks curving the waist.



The two views above show the motorcycle with pontoon side car being put through its paces at a recent demonstration at Hampstead, England, on land and crossing a pond. Summer campers, it is thought, will find the side car especially advantageous, since they can ride on water, park the cycle, and go for a row in the water-tight side car.



How good is your shovel? Here is an ingenious device that would test it for you. Its handle heavily weighted, the shovel is placed in a bin of broken stone and dragged back and forth by machinery over the rough rock until it breaks. The number of hours it takes to wreck it determines how good it is. A Western railroad company devised the method to guide it in its purchases.

The familiar H-shaped standards for high jumping will be a thing of the past, if this new device, now in use at the University of Washington, is generally adopted. With nothing above the bar, the new standard relieves the athlete of the "mental hazard" caused by the ordinary posts. Adjustable to any height, the post is locked in position with a hand lever as shown in the small inset picture. The crossbar, however, is always loose to avoid possible injury should the jumper foul the bar.



New Fire Apparatus Clears Building of Smoke



Smoke-eating fire apparatus at a recent demonstration

CLOUDS of suffocating smoke that hamper the work of firemen can now be sucked out of a burning building by a brand-new type of fire apparatus, the invention of C. W. Ringer, of the Minneapolis fire department.

Mounted on a standard fire truck, a fan blower especially adapted to the purpose draws out the smoke through a metal tube and discharges it in the open air. With the building at least partly cleared of fumes, the firemen's work is made easier.



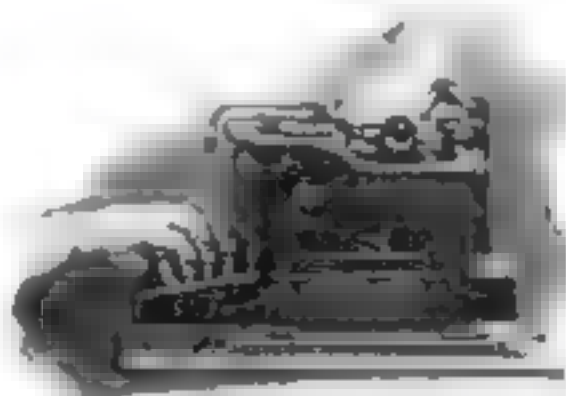
Keyhole Lock Baffles Thieves

LOCK your door, slide this odd-shaped device into your keyhole when you retire for the night, and insertion of another key from the outside is effectively barred, says its maker. The triangle-shaped catch on the barrel grasps the inside plate and cannot be released other than by the special key—used for unlocking only, as the device locks automatically. A steel ball bearing in the tip is intended to baffle any attempt to drill out the keyhole obstruction.

Typewriter Drumming Deadened

EASIER on the ears and the finger tips is a typewriter fitted with one of the new shock absorbers that soften its bang and rattle. No felt or rubber is used. Instead, two strips of spring steel, supporting the machine so that it cannot communicate its vibration to the desk top, deaden the drumming that usually results. The resilient spring steel gives a lively "touch" less fatiguing to the fingers, and is said to give longer life to ribbons and rations.

No tools are required to attach the device to the desk, a locking lever being used. It is made to fit several standard makes of typewriters now on the market.



Placed between the typewriter and the desk, this spring steel device deadens the drumming and gives the fingers a lively "touch"

New Telescope for Studying Sun

CHANGES in the sun's face, previously perceptible only on photographs, may now be studied visually with a new instrument called a spectrohelioscope, invented by Dr. George Ellery Hale of the Mt. Wilson observatory, California. Using this instrument, Dr. Hale has been able to watch the behavior of the whorls of hydrogen around sun spots. These glowing gases give off lights of characteristic colors, and his spectrohelioscope can be set to observe one particular color element in much the same manner a radio set can be tuned-in on one particular station.

Tiny Mirror Set in Finger Ring



Shaped to reflect your whole face

SET with a diminutive mirror instead of a precious stone, a new finger ring combines ornament with utility. On its tiny convex surface it reflects the entire face of the wearer. The mirror is made of glass, silvered and then coated on the back with a waterproof

paint. It is of new design, ground and polished like a fine lens. As a novelty it is affording much amusement, enabling the wearer to watch other people to one side or back of him unnoticed.

Chemists Make Artificial Milk

SYNTHETIC milk, possessing all the nutritive qualities of the genuine article, is a new triumph of chemists reported from Denmark. Vegetable fats replace the butter fat of cow's milk, and vitamins are added to complete the similarity. The product, which is in no sense a mere substitute but a complete duplicate, its makers say, is about to be manufactured on a commercial scale.

Double-Deck Street Eases Chicago Traffic Jam

ELEVATED highways may carry the traffic of the future, if Chicago's new double-decked avenue, the first in that city and one of the first in the country, proves the success expected. Recently completed and thrown open to traffic, Wacker Drive now carries streams of motor vehicles on two levels for more than a mile along the bank of the Chicago

River, in one of the busiest sections of the city. Graceful archways and columned walls help to make the new double-decker thoroughfare an artistic addition, rather than a detriment architecturally, to the city.

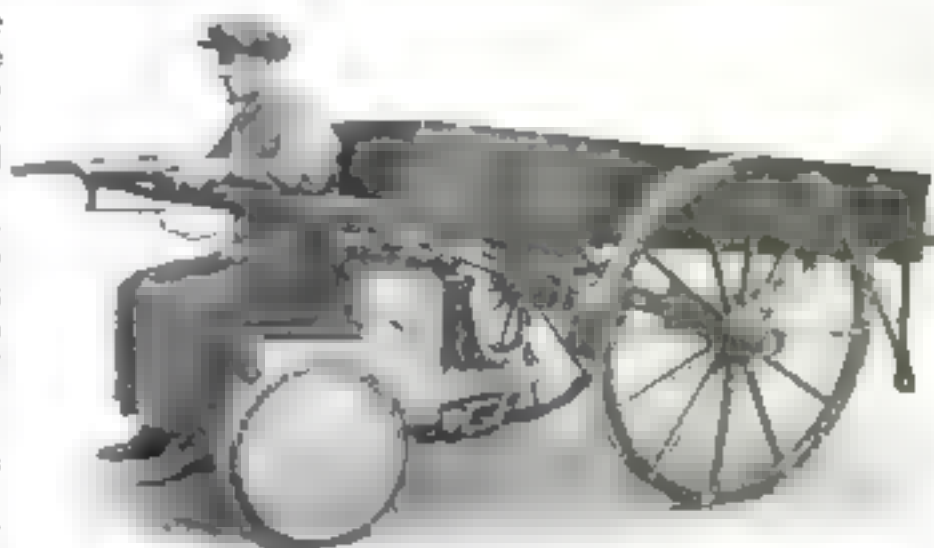
In New York City a similar plan has been suggested to ease the congestion of its crowded streets and avenues.



Wacker Drive, Chicago, as it looks today with its elevated highway for auto traffic

Electric Motor Now Pulls the Pushcart

PUSHCARTS are brought up to date and made into motor carts by a new attachment recently devised in Germany—an electric motor that permits the carrier to be loaded or dumped as a hand truck. Then to be whisked speedily from place to place in the modern manner. An unusual feature is the comfortable seat from which the driver controls his powerful little machine.



Especially adapted for transporting baggage on railway platforms

Billiard Cue Tip Stays "Put"

IT'S as easy to put a fresh tip in this new cap for billiard cues as to insert a new bullet in its holder. The usual cue tip consists of a fragile piece of leather glued to the end of the cue; in the new invention, the tip is held securely by a threaded metal sleeve that screws on to the cue. When the tip needs replacing, the sleeve is removed in a moment to insert a new one. A set screw keeps the container from working loose accidentally while the cue is being used.

Sees Airships Driven by Diesels

WILL airships of the future be driven by light, high-speed Diesel engines, thus doing away with the danger of explosions and fires from the motors? Dr. Immanuel Louster, managing director of the Diesel Company at Augsburg, Germany, visiting America, says his company is now developing a motor for dirigibles. The fact that the Diesel does not need a spark for combustion and also that it uses heavy oil for fuel is thought to make it especially desirable for airships.

Britain Sets Train Speed Record

OVER the tracks from London to Birkenhead, a British express train thundered the other day at ninety-two miles an hour to make a new speed record. Behind the powerful engine, 230 tons of steel made up the special train that pounded the rails. England is generally conceded to be well in the lead in railroad speeds, and this journey sets a new high mark for others to try to beat.

Electric Cooking School Travels on Wheels

NOW the little red schoolhouse goes chugging about the country, rolling on four wheels and propelled by a motor. Housewives in Westchester County, N. Y., are receiving instruction

Manicure Set Fits in Hand Bag

ONE tiny box holds all the articles above, needed for manicuring. The reverse side of the cover serves as buffer. Within are found orange stick, emery board and nail file; while two pencil-shaped containers that slide unexpectedly from the ends of the holder carry nail polish and whitener.



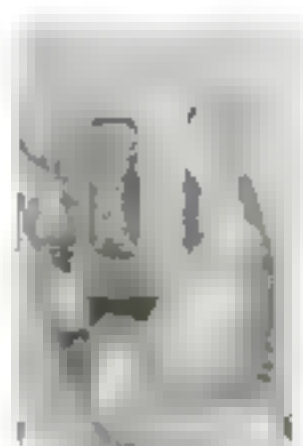
Fine Linens May Be Cheaper

HOUSEWIVES will rejoice in cheaper linens, if two machines for obtaining the fine flax fiber, recently demonstrated in Boston, Mass., prove commercially practicable. The present way of getting the fiber is to soak the flax straw for days in slow-running water, then dry it, and then beat it to remove the woody core. These two machines do the same work, taking as many hours, it is said, as the former method took weeks. One is a roller machine, the other a large vat.

In the success of the inventions is seen a vast potential development for the linen industry, which today still uses processes devised 4,000 years ago.

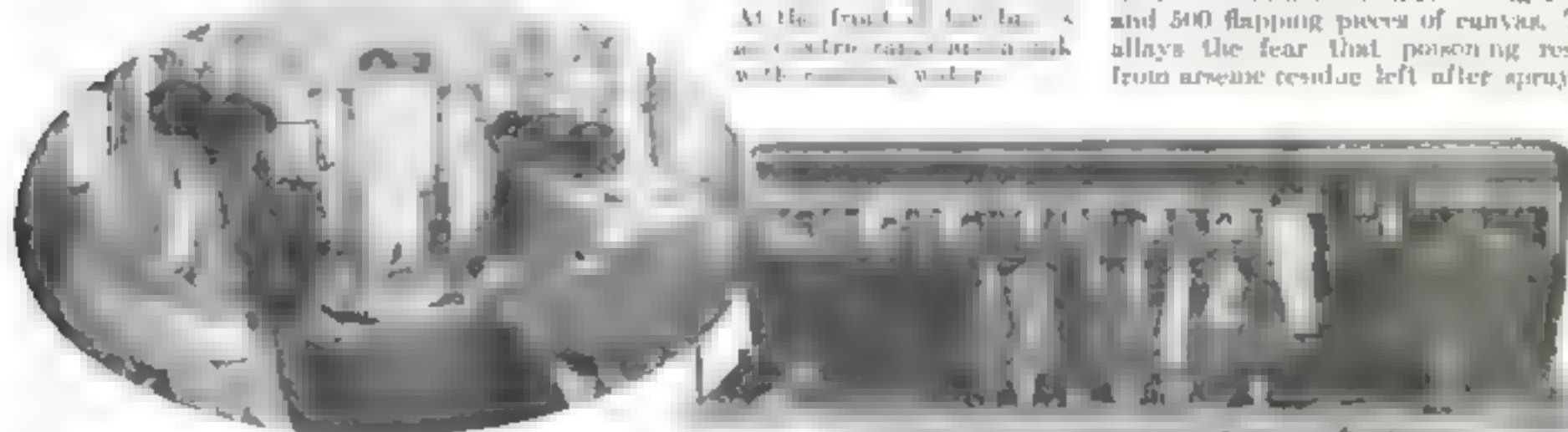
Cake of Soap Holds Nail Brush

NAIL brush and soap go together, but it took a Frenchman to think of combining them in one handy article. Ready for a quick brightening up after a dusty day's work, the brush is set in the middle of a bar of soap. The other side of the cake is of ordinary appearance.



A novel soap-and-brush combination

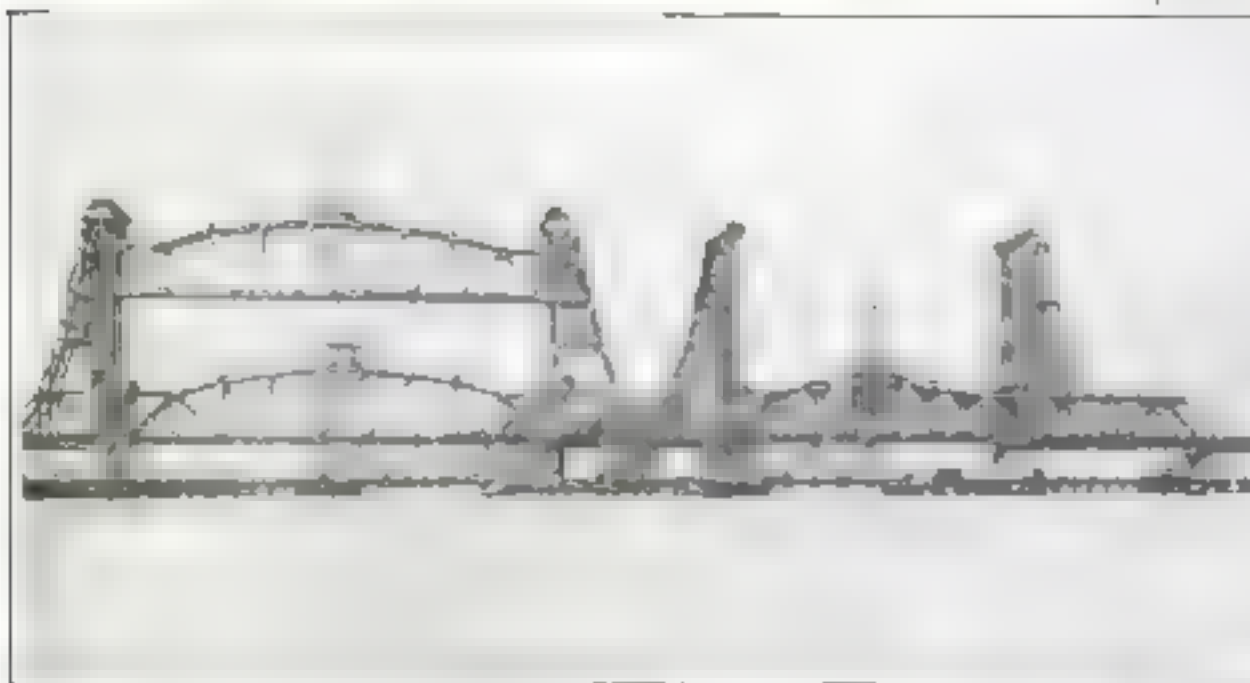
APPLE growers have developed a new device for wiping apples: an odd contrivance with horizontal revolving rollers and 500 flapping pieces of canvas. This allays the fear that poisoning results from arsenic residue left after spraying.



Class assembled for a lesson in the "educational bus." At the front is space for a sink with running water, electric range and smaller appliances, a table and cupboards.

Westchester, N. Y., housewives "go to school" again when the traveling cooking school comes to town. Correct home lighting, child care and the care of linens are other subjects taught. The bus has seats for thirty-seven persons.

Jersey Bridge an Engineering Triumph



A FEW weeks ago the largest vertical lift bridge in the world was opened to traffic. Engineers who built it flung four mighty spans across Newark Bay to connect Bayonne and Elizabeth, N. J. Each span is 800 feet long, and rises like

a giant elevator to a height of more than half its length to permit vessels to pass beneath it. A clearance of a hundred and thirty-five feet above the water surface is provided for

Each of the four spans was 100 feet wide at the base and 100 feet high at the top. The bridge is 1,000 feet long and 100 feet wide. It is the largest vertical lift bridge in the world.



The Horse That Never Grew Up

"PEE WEE," a pygmy horse owned by John C. Macadema of Newark, N. J., weighs an even hundred pounds and is only twenty-seven inches high, though already he has attained the mature age of five years. Our horses' ancestors, which lived thousands of years ago, were only three feet high, and "Pee Wee" therefore, gives us a good conception of what they must have looked like.

Soft Colors Aid the Sick

COLOR as a factor in rest cures has demonstrated its importance in a London hospital. Under the guidance of color experts, white walls and red coverlets have been replaced with delicate green, yellow and mauve ones. As a result, it is said, the temper of the patients is better, they sleep well, and leave the hospital an average of three days sooner than under the old conditions. The officials report that one individual, afflicted with chronic insomnia, went to sleep within an hour in the restful atmosphere of a room which was decorated in mauve.



Huge Kite Takes Boy for a Ride!

NONCHALANTLY swinging in a rope seat from a giant kite, Francis Perkins above, thrilled a crowd of on-lookers in a unique kite-flying exhibition at a recent Massachusetts fair. A cable attached to the kite supported the boy, whose father, Sam Perkins, designed the kite.

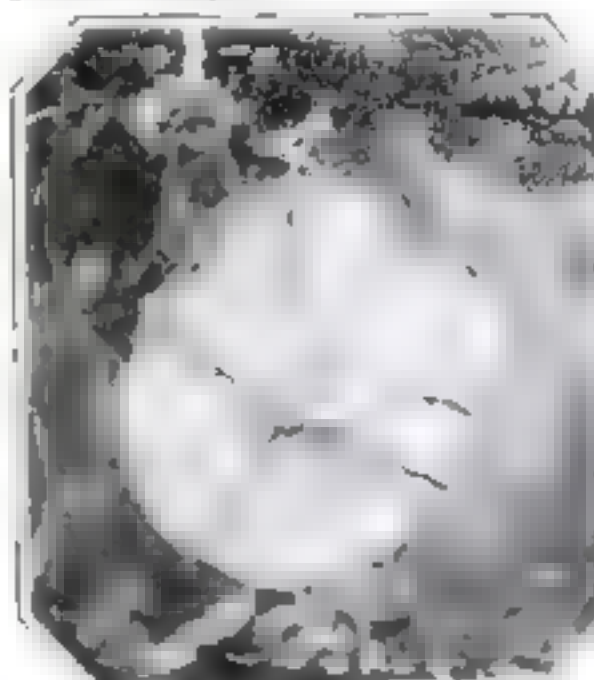
How Much Do You Know of the World You Live In?

YOU LL have a fairly accurate answer to this query after testing yourself with the twelve questions below, selected from hundreds sent in by our readers. For the correct answers, turn to page 160.

1. What state leads in the development of water power?
2. Where are the helium wells of America?
3. Where can you walk a degree of longitude in a few minutes?
4. What great invention did the Aztecs lack?
5. Where is building stone sawed like wood?
6. What is vegetable ivory?
7. What is the greatest fishing port in the world?
8. What people always wear masks in public?
9. Why is preserved food often found in ancient Egyptian tombs?
10. What is the most beautiful building in the world?
11. What is the most valuable nut?
12. Where can you get vegetable milk?

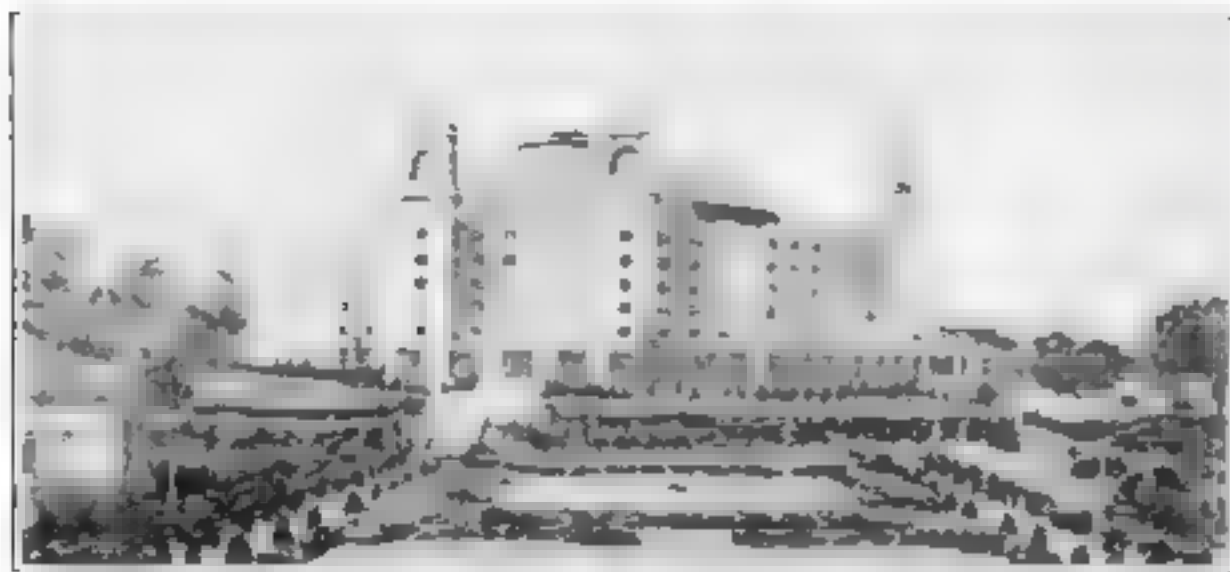
Glacier Gives Up Ancient Tree

PRESERVED a good 100,000 years ago, the trunk of a spruce below was cut was exposed again to the open air by the recent recession of the great North American ice cap in Glacier Bay, Alaska, and was found by a Canadian government party. It grew for 124 years before the advance of the glacier enveloped it.



Cross-section of ice-preserved Sitka spruce, which blossomed in Alaska 100,000 years ago.

World's Largest Dome Tops Indiana Hotel



THOUGH St. Peter's Cathedral in Rome is still the largest cathedral in the world, contrary to general belief it can no longer claim the greatest dome in the world. That distinction belongs to a hotel at West Baden, Indiana, pictured above, which surpasses by twelve feet the noble dome on St. Peter's. The hotel dome is 200 feet across.

The triumph of the American builders

Diving in Thames a Muddy Job

THE hazardous occupation of the diver, encumbered with a heavy suit that limits freedom of movement, is made extremely more so in the Thames River, England. Here the water is at all times so muddy that the diver has to work with bare hands, feeling every inch of his way because of inability to see an inch ahead of him through the thick glass plates in his helmet. He also has to watch his step carefully, because the mud bed of the river is precariously slippery and full of holes.

The illustration below shows a twelve-inch steel suction pipe being lowered to the Thames River bed, to be guided and connected by the diver. The helmet at the end of the hose hides the features of James Mearns, whose experience at working at underwater jobs began at the early age of fifteen years.



Lowering a pipe in the Thames River—a job so muddy the diver must feel his way around

lay in the solution of the problem of supports adequate in strength to uphold the immense dome. As completed, it rests on sixteen solid brick piers laid up in lime mortar. In this respect the design follows closely that used by the ancient craftsmen. The lime binds the masonry into an imperishable mass because of its ability to absorb carbon dioxide from the air to unite with the sand and bricks.

A TREE that yields "milk" has been discovered in Central America by Professor S. J. Record, of Yale University. This arboreal cow is "milked" by cutting into the bark, and the liquid that pours forth is described as "rich and creamy, palatable, and sweet to the taste."

KNOW YOUR CAR

THE front and rear wheel bearings of a modern automobile are so perfectly designed and constructed that the motorist is apt to forget them completely. For five or ten thousand miles the car will go without any sign of trouble even if they are never so much as greased. Eventually, however, the ball or roller bearings run dry and then wear sets in. The balls or rollers gradually grind away the hardened steel surfaces on which they run and then the motorist suddenly discovers that one of the front wheels is wobbling or there is a grating and grinding noise coming from one of the rear wheels. By that time the wear probably has progressed to the point where a whole new set of bearings is necessary to put the wheel back into running condition. Aside from the inconvenience caused by putting the car up for the needed repairs, any defect in the running gear is liable to result in a serious accident. The broken bearing may seize and throw the car off the road while you are traveling at high speed.

There is just one rule for safety as far as the running gear of your car is concerned.

Inspect, grease and adjust the wheel bearings at least once every 5,000 miles.



Now We Have Sociability Tests

CAN a person's sociable qualities be determined by laboratory tests? Prof. J. B. Mearns of Northwestern University declares that they can, and he has devised tests by which, he says, parents can decide how to train children.

In the picture above, the subject is being tested for susceptibility to sound. She is placed in a quiet room and her ears are covered with an audiometer while she looks into a crystal to induce daydreaming. Her reactions to sound are then noted. One who is distracted by the faintest sound is said to be too sociable while one who daydreams in spite of loud noises is more hermitlike.



Uncle Sam's Own Whiskey Still

BELIEVE it or not, in a certain building in Washington, D. C., belonging to the Treasury Department, the Government is running a corn whiskey still, and here are two Government employees operating it. Nothing, however, comes out of the still now except pure, harmless water. Confiscated in a raid and turned over to the Treasury Department garage, the apparatus is used to distill water for Government storage batteries.

Bifocals Now "Color-Free"

HOLD the ordinary fused bifocal eyeglass lens up to the light and at the point where the image reverses you will see a narrow fringe of color. This color fringe, which has always annoyed bifocal wearers, is now said to be entirely done away with in a remarkable new type of bifocal lens.

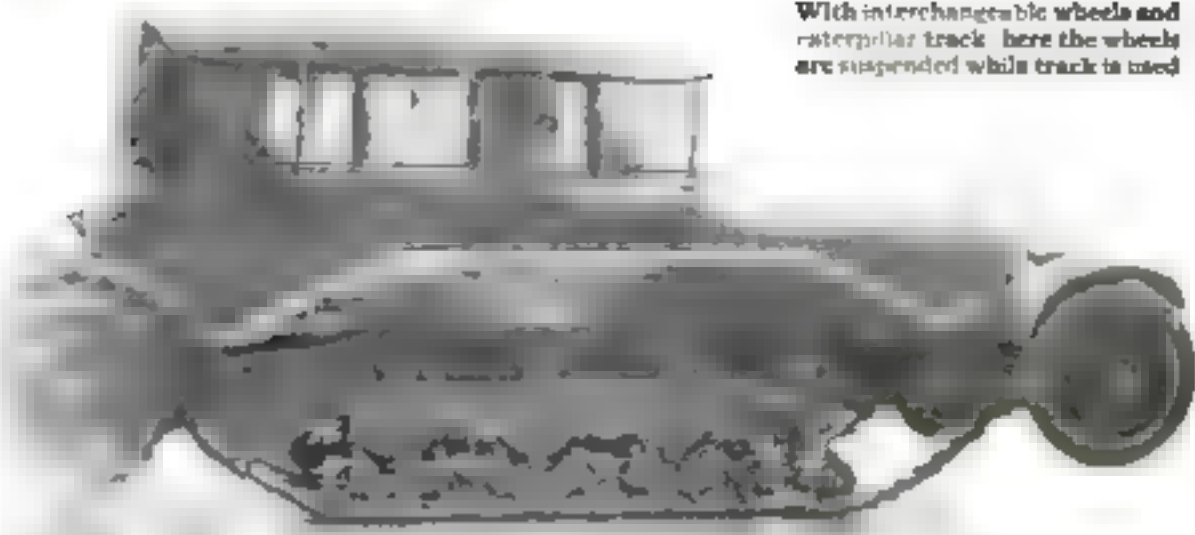
Up to now, when two lenses were melted together to conceal the dividing line of the near and far vision lens, this color aberration was caused by the dense flint glass long considered the only possible material for the reading segment of the lens. An entirely new type of glass, produced for the first time in the laboratories of a great optical company, is responsible for the new "color-free" bifocal lens, shown being tested below.



Testing the new bifocal lens to show that its shadow casts no color fringe

Magnetic Crane Unloads Cars

SO COMPACT that it can be put inside a freight car and set to work unloading it, the hustling little crane below has a powerful magnet at its business end. It picks up loose metal parts from the car floor and loads them in bags and boxes. In the illustration, the crane is seen backing away from the railroad siding with the last load after it had set a record by unloading an entire car full of loose castings in forty-five minutes. The best previous time for this work of the new crane was three hours. For its size, the new machine is sixteen times faster.



With interchangeable wheels and caterpillar track here the wheels are suspended while track is used

Convertible "Tank Auto" Rides Over Anything

WITH a car like this, there's no danger of getting stuck in the mud. Just a touch of a lever and this army touring car becomes a tractor, with a caterpillar tread that will take it over any obstruction. The change is made by

its own engine power, and is said to require less than a minute. Recently shown at Canterbury, England, the new car is intended for military use. It travels over roads at high speed, and plows cross-country like an army tank.

This Kiddie Car Wags Its Tail!

A NEW variation of the little three-wheeled vehicle for children is shaped like an animal, whose eyes roll and jaws open and close—even the tail wags. Another car has an animated doll whose feet appear to operate the pedals. The inventor of these two realistic toys is Frederick Herschman, of New York City.



Phonograph Disk Won't Break

SLAM this new phonograph record, below, on the floor—kick it, or, if you like, double it over and step on it—and it won't break. Now put it on a talking machine, and the sharpest ear might fail to distinguish its music from that of an ordinary disk. Such, at least, are the claims made for this amazing invention, which has just been placed on the market, by its British manufacturer. It is made of a plastic material said to make breakage impossible.



Bending and stretching the new British phonograph record as a test of its remarkable pliability

Magnetic tape contained by an automatic crane. A lever to make magnets for cars. The crane picks up the magnets and deposits them in boxes. This work was formerly done by men, but the power magnet works sixteen times faster.

A New Way to "Lick" Envelopes

MICROSCOPIC holes in the cap of this handy desk accessory release just enough of the water it contains to seal the flap of an envelope over which it is rubbed. The holes are so small, it is said, that no water can leak even when the device is held upside down, until a stamp or envelope pressed against it will draw moisture by capillary attraction. An occasional filling and a casual wipe across the cap with the hand are sufficient to keep the moistener clean and ready for service.

Lightning Rods for Oil Tanks

BOLTS from the sky that threaten to turn huge oil tanks into roaring pillars of flame may in future be harmlessly deflected by a new method tested in the laboratories of the General Electric Company. A metal pole erected near a tank, it is said, protects from lightning an area of a circumference equal to four times the height of the pole. Several such rods around an oil reservoir, the tests showed, will completely protect it, and a network of wire screening carried above the tank would make it impossible for atmospheric charges to cause sparks that might play about the metal and ignite the oil within. Artificial lightning was used to test the small scale laboratory models of tanks to obtain this information.



Armored Motorcycles Aid Cops

WARLIKE in its armored construction and scolding appointments, this remarkable motorcycle side car, which has just made its appearance in Berlin, is the last word in equipment for field campaigns against bandits. With a bullet-proof side car is a complete radio receiving set, to receive latest bulletins and instructions from police headquarters. The auxiliary vehicle runs by itself, and may be detached from the motorcycle at a moment's notice to make a flying road under its own power.

Stockings from Redwood Trees

EVERY part of the majestic redwood tree of California has been put to use except the bark, which has hitherto represented the only waste when one of these forest giants has been felled. Now scientists propose, instead of throwing the bark away, to make silk from it, if experiments by the California Redwood Association prove successful. Artificial silk has already been made from wood pulp, but the majestic *Sequoia gigantea* has never before furnished the material.



Device Tilts Pen Ready for Use

NO HARM can come to your fountain pen in this ingenious desk set. The socket that receives the idle pen terminates at its base in a ball that moves freely within a cup attached to the stand. At one point on the rim of the cup, a slot permits pen socket and pen to drop flat, so that the entire set can be tucked away in a shallow drawer overnight. Placing the socket in any other position holds the pen tilted upward, ready to the hand, and able to swing freely out of the way if accidentally struck.

Seven-Yard Craft Folds to Knapsack Size



TWENTY-ONE feet long when rigged for water travel, the substantially built, two-passenger craft above is "light as a feather," says its inventor, and can be folded up and carried on the back like a knapsack.

To prove its seaworthiness, Herman Glattfelder, the young inventor, made a successful trip the other day from Governor's Island, N. Y., across Upper New York Bay to the Battery, at the foot of Manhattan Island. He is shown carrying the boat on his back before the demonstration. Its total weight is only twenty-five pounds, and Glattfelder says it is nonsinkable. Note, in the picture above, the unusual design of the boat.

The inventor carrying his boat, folded, on his back, like a knapsack. It weighs twenty-five pounds.

What Artichoke Sugar Will Cost

LEVULOSE, called the finest of all sugars, is prophesied from artichokes at two cents a pound within five years, as a result of further experiments by the U. S. Bureau of Standards. Crystallization of the levulose from a water solution marks the turning point of the Bureau's experiments, for in all previous work treatment with alcohol was necessary. The new step is said to place artichoke sugar on the same footing with cane or beet sugar as a commercial process.

Fountain Pen in Umbrella Handle

REMOVE the ornamental top of the latest umbrella, and out pops a fountain pen! Thus have inventors found a use for the hitherto waste space in an umbrella handle. Women will appreciate the convenience, for vanity cases and bags are often too small to carry pens.



Unscrew the handle top and out springs the fountain pen, fitted snugly in the hollow tube.

Convict Invents Mail Bag Lock

TO STOP thefts from mail bags, a new lock has been invented by a Canadian convict, in whose name a patent will be taken out. The device is said to make ropes, bars or straps unnecessary, lessening considerably the weight of each bag. Norman ("Red") Ryan, notorious Toronto bandit now serving a life term for bank robbery, is the inventor.

Clock Built Entirely of Straw

STRAW was the only material used by a German clockmaker in the construction of a unique clock six feet high. Pendulum, twelve clockwork wheels, and case are all fashioned from this material. The novel timepiece has a twenty-four hour movement and represents two years' work by Karl Reichert, one of the skilled artisans of the clock-making town of Goslar, in the Harz Mountains.

Copper Skewers Speed Roasting

SKEWERS or pins of copper run through a roast result in quicker and more even cooking and juicier meat, according to the home economics department of the University of California. Copper is an excellent conductor of heat, and these skewers carry the heat directly to the inside of the meat, cooking it through in a third less time.

Report New Cure for Malaria

GERMANIN, a coal tar product, is a newly reported cure for malaria, developed by experimenters in the laboratories of the Bayer-Lever-Kusen Chemical Works, Germany. Canaries were used as test patients, and a final test of the medicine was made by an expedition to Central America, which reported complete success in curing malaria.



Fleet Little Racer Runs on Three Wheels

SPEED is emphasized in the trim lines of this remarkable new three-wheeled racer which steers with the two front wheels while the single rear one trails. The streamline body encloses a motor capable, according to the Paris makers, of hurling the bulletlike car along a country

road at eighty-five miles an hour. Yet, they say, the speedometer dial will show another forty-five miles covered every time the engine burns up a gallon of gasoline.

Pleasure cars of this type are being made also, it is reported, by the same maker.

Tests Tightness of Plane's Wing

HOW tight should the covering on an airplane's wings be? A new instrument, perfected at the U. S. Bureau of Standards, tests the tautness of the fabric stretched over the wings, and also measures the tension of the cloth that holds a dirigible's precious helium. An oval shell, attached by suction to the wing or gas bag, creates a partial vacuum until an indicator shows that the fabric has been pulled an eighth of an inch out of line. A gage indicates the amount of suction required to do this, which is converted into pounds of tension per inch of width. Extremely accurate measurements have been made with the new meter.

HALF AS BIG as a brick, patch black but shot through with green and peacock blue fire, the largest opal in the world is now in the U. S. National Museum. It was found in a bed of volcanic ash in Virgin Valley, Humboldt County, Nevada, weighs over eighteen ounces, and is surpassed by few in quality and beauty.

Sectional Auto Window Slides Open Sideways

SIGNALING from a closed car is easy with one of the new sliding glass panels installed in your left-hand door. In winter months or during a summer rain, when all the windows are shut up tight you don't have to crank one down to let the car behind you know which way you're going to turn or to tell the filling station man how many gallons of gas you want. A touch of the finger, and one of the half sections is pushed open.

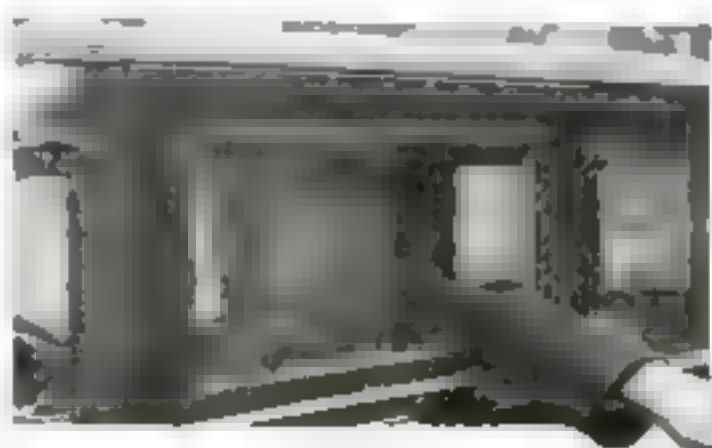
The new panel consists of a wood frame, covered and finished to match the car exterior, and designed to fit in the regular slots of the car door. It has two half sections of glass, one of which slides horizontally. It is installed simply by inserting it in the open window space after the present glass has been lowered all the way. Raised

Your Latchkey in Your Penknife

CONCEALED in the handle of this slim penknife, your house key is always at hand when you need it. The removable tip of the knife carries a key "blank" to be filed to fit your door. Replaced, the novel latchkey joins with the rest of the case to make a conventional penknife that attaches conveniently to your watch chain, to be tucked away in your vest pocket for ready use in either of its services. The penknife part of this novel accessory contains two steel blades.

then as far as it will go, the old window holds the new one firmly in place. A rubber strip is provided on the lower outer edge of the frame to prevent air or rain entering at this point.

The adoption of this adjustable type of car window is being considered by builders of closed car bodies.



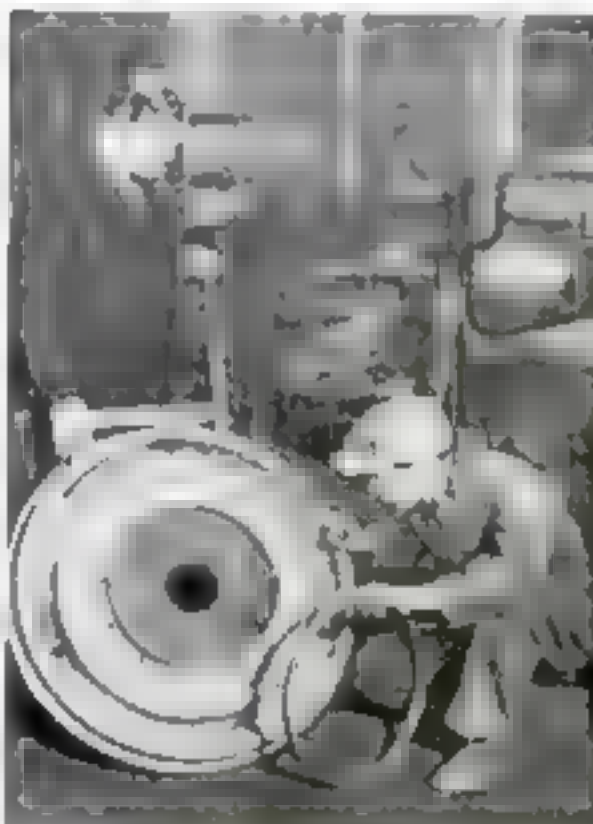
The window is in two sections, one section sliding sideways over the other when you want to signal. The old window is still in

Toys Made from War Shrapnel



DEADLY shrapnel is turned over into peacetime use at a Hornsey, England, factory where nearly three hundred tons of shrapnel removed from shells are being melted down and converted into toys. Cast in various sizes and the destruction, the metal is fashioned into miniature animals and other figures. The last trace of their warlike origin disappears as the models are painted in natural colors.

These models will be used to complete exhibits of model farms.



Now—Rubber-Tired Trolleys!

TROLLEY cars may soon be fitted with pneumatic tires and glide along silently and smoothly. If an amazing car wheel now being tested proves practicable. It is the invention of S. C. Hatfield, of Baltimore, Md. Instead of encircling the rim as on an auto wheel, the tire is at the center next to the hub, as shown above, so that the tire itself never comes in contact with the track.

A Baltimore transit company has equipped an experimental trolley with the novel wheels. Should the tests prove successful, trolley cars for the first time may be equipped with roller bearings, too fragile to use now. Slightly modified, the new wheels are said to have been used successfully on heavy motor trucks.

The Most Amazing Factory in the WORLD!



Movie actors no longer fear "Klieg eyes" from studio lights, as a result of Bureau of Standards experiments. Dr. W. W. Coblentz, of the Bureau, is holding a screen of a new glass developed containing cerium oxide, which absorbs the harmful rays in the lights.

*Strange Machines, Hurricanes,
Even Fires, Manufactured at
Bureau of Standards, to Test
Every Article You Buy or Use*

An Interview with
DR. GEORGE K. BURGESS
Director, U. S. Bureau of Standards

By M. K. WISEHART

IN A corner of one of the hundred laboratories which are part of the Bureau of Standards in Washington, D. C., there is a contrivance which I think would strike you as curious. It looks more or less like an elevator—but an elevator all dressed up with no place to go! There is no shaft for it to operate in. No elevator man sings out, "Going up!"

Busily sliding back and forth, opening and shutting, locking and unlocking maybe fifty times as you stand there, is an ordinary elevator door. Night and day for two weeks it does the same. What for?

Some time ago, the people of Baltimore discovered that more deaths from elevator accidents were occurring in their community, relatively, than in others. The cause—doors of elevator shafts were open when the elevators were not there.

Now, every properly equipped elevator has a safety device known as an "interlock." Its purpose is to make it impossible to operate the car until the door is closed. In the Baltimore fatalities, these so-called safety devices simply had not worked.

The Baltimore authorities came to the Bureau with this problem: "Is there on the market any absolutely dependable interlocking device? How can such a device be made dependable?" It was to answer these questions that we built that elevatorlike contrivance. Interlocking devices are tested on it.

LOOK inside it and you'll see that it really has an elevator man, too—a dummy, of course, run by electricity, but a remarkable fellow for all that. He not only opens and shuts the door, he is continually trying to work the controller of the

car when the door is open. Also, he keeps trying to open the door when the car is not at the door! In short, he does the things the elevator man is expected to do and the things he ought never to do. Moreover, in red ink—autographically—he records on a chart every time that the safety device fails to work and lets him do the things he shouldn't!

In the course of two weeks, working day and night, our tireless dummy elevator man puts the safety device to a test more times than it would be used in five years in actual service. He tells us how the

device works when it is new, when it is worn, when it is properly greased, when it is not greased, when the air is filled with dust as in a flour or cement mill. With regard to faulty devices, he tells how many times in the next five years they may be expected to make fatal accidents possible.

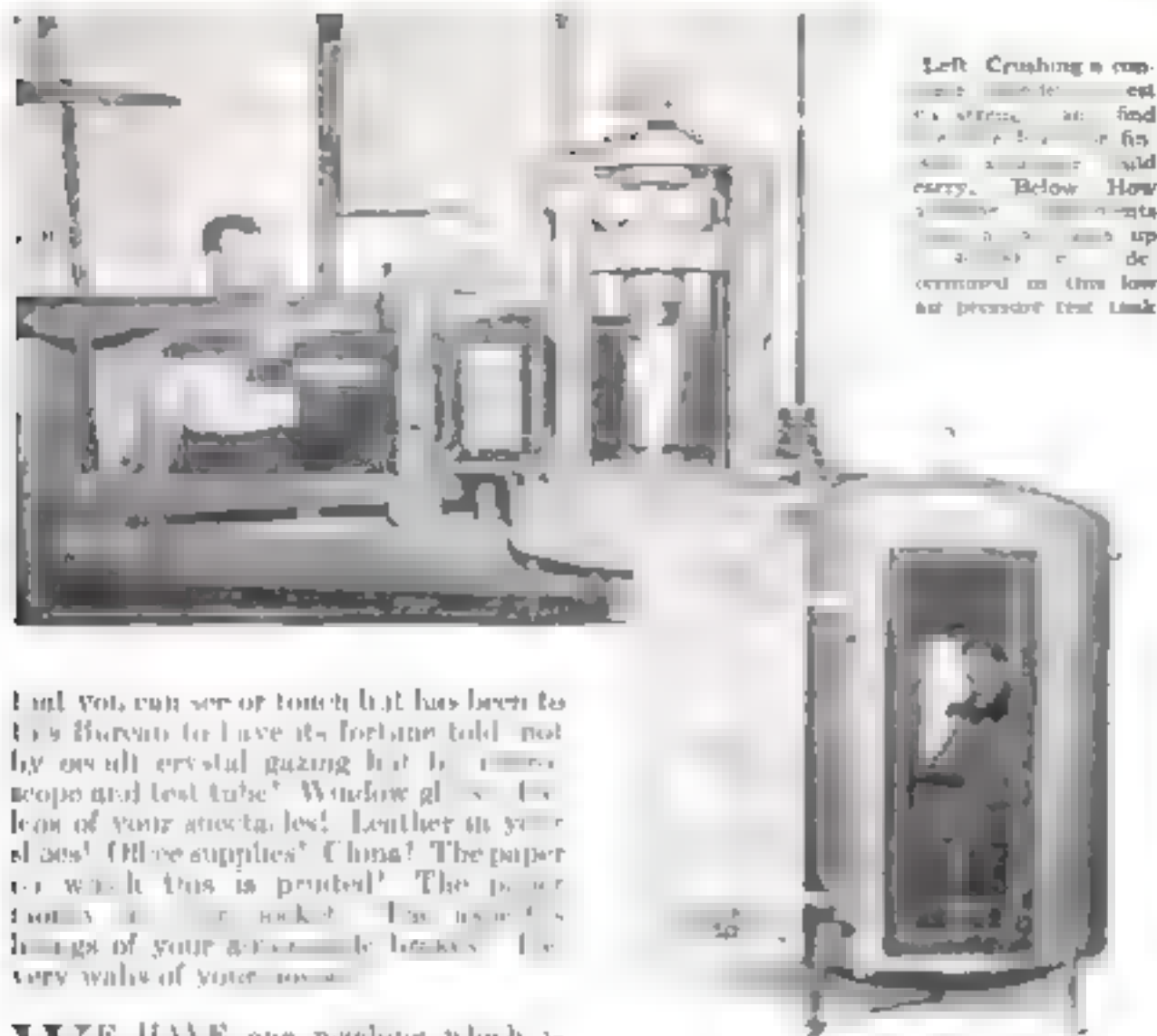
When the Baltimore tragedies were brought to our attention, we tested in this way every interlocking device on the market. Results of the tests were sent to all makers of interlocks as well as to elevator manufacturers. Defective devices were either withdrawn from the market or redesigned. Today, every elevator manufacturer in the country is equipping his elevators with dependable devices. Baltimore and other cities have written into their safety codes definite interlock specifications. Owners of elevators are saving \$400,000 a year in insurance premiums on elevators equipped with interlocks that pass the Bureau of Standards test. In short, the work of our dummy elevator boy is annually saving scores, perhaps hundreds, of lives!

AND that is only one of more than a hundred and eighty thousand tests made at the Bureau of Standards last year. Imagine an institution with twenty great buildings and a thousand employees, half of them trained technical men, physicists, chemists, engineers—all engaged in tearing apart, wearing out, and building anew every article you buy or use! Everything, from automobiles to sealing wax, from paper clips to photographic films, building materials, tableware, writing paper, safes, watches, fire extinguishers, electric lamps, and airplanes!

Look about you! Scarcely an article



Finding out why some of your shirts and socks wear out faster than others: part of the textile testing equipment



Left: Crushing a compressed brick pier. Below: How fast does your shoe leather wear out? This is the test machine.

And you can see or touch that has been to the Bureau to have its fortune told—not by occult crystal gazing but by microscope and test tube? Window glass? The lens of your spectacles? Leather in your shoes? Office supplies? China? The paper on which this is printed? The paper from which this book is made? The iron in the hinges of your automobile trunk? The very walls of your house?

WE HAVE one machine which is among the most powerful mechanical forces man ever created. It has a crushing force of ten million pounds. Into this machine we feed a solid brick pier, set in cement, three feet square, nine feet high. Pressure is applied from the bottom, which is a movable platform operated by oil pressure. At the weakest point in the pier a crack appears. It spreads and widens, usually in a zigzag course. The results are observed and charted by structural engineers for developing specifications that will prevent defects in actual building.

Engineers building the big suspension bridge over the Delaware between Philadelphia and Camden recently devised a new type of column, of structural steel. What such a column might be expected to bear could be figured by engineering formula, but could the formula be relied upon? One of these columns was sent to the Bureau to see what would happen to it when the giant crushing machine took it in its viselike grip. It turned out that the column was equal to supporting not only the weight necessary, but a hundred percent more—a matter of six million pounds. A comforting thing to know for both the engineers and the people who use the bridge.

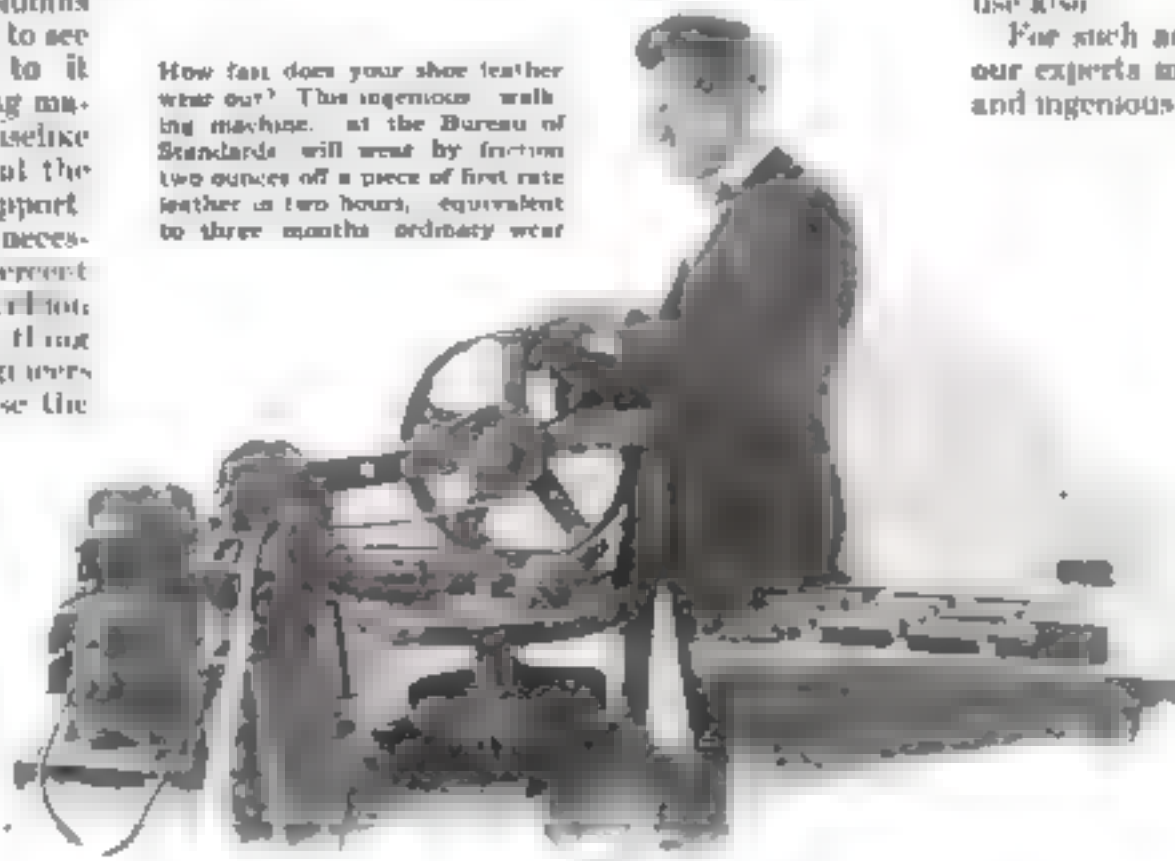
Nowadays, when a business man buys a safe, he purchases a machine that is designed to meet a certain hazard. If it is to be kept in surroundings that expose it to what is known as a "two-hour fire" he buys a "two-hour safe." If the surroundings are more

inflammable he may buy, at greater cost, a "four-hour safe."

Owing to new and more effective insulating materials now used between the walls of a safe, the safes of today are much lighter than formerly. How do we know that these comparatively lightweight safes give adequate protection?

Here at the Bureau we have several brick buildings in which tremendous fires are created for experimental purposes. We have learned that a one-hour fire in a certain type of office building produces a temperature of 1700 degrees Fahrenheit—cherry red heat. In two hours such a fire reaches 2,000 degrees—white heat. Now, suppose we put our two-hour safe in a gas furnace and heat it to 1700 degrees; its condition is then what it would be after

How fast does your shoe leather wear out? This ingenious "walking machine" at the Bureau of Standards will wear by friction two ounces off a piece of first rate leather in two hours, equivalent to three months ordinary wear.



a one-hour office building fire. Since, in an actual fire, at the end of an hour, the safe may be expected to drop to the floor below, or perhaps to the cellar, the heated safe in our test is raised by a hoist and dropped from a height of thirty feet. After this it is put back in the furnace and heated for an hour to 2,000 degrees.

ON OPENING the safe, what do we find? In one experiment, we actually found that the papers inside were slightly brown and somewhat brittle, but not scorched! After such tests, of course, it is possible to say how a safe should be made to meet a definite fire hazard.

Have you any idea what fire losses in the United States amount to annually? If we reckon only the property destroyed—over \$300,000,000! If we include contingent losses, interruptions to business and the like, the total is staggering, more than \$1,000,000,000! The annual loss could be represented by fire ruins in a solid row along a highway extending from New York to Chicago!

One of the important investigations on which the Bureau is now engaged has to do with fire-resistant building methods. In a giant furnace we build structural members such as are used for the main support of office buildings, factories, and storehouses; and we subject them to fire under conditions that enable us to determine exactly what they will stand and how they can be made more enduring. We do the same with full sized walls of houses.

CONGRESS established the Bureau to maintain and construct standards for use in American industry and commerce. Every year we make thousands of tests at the request of individuals, business firms, and for state and municipal authorities. But the great majority of them are for the use of the Federal Government in purchasing supplies. Many of the items the Government buys are the same that you buy for personal use. Of course, when manufacturers, in cooperation with the Bureau, improve their goods to meet the requirements of the Government, they usually put the same quality of goods on the market for your use also.

For such an amazing variety of tests, our experts must constantly develop new and ingenious testing machines. Many of them are inventions of a first rate order. The wear that these machines give an article imitates the wear and tear the article must undergo in service. However, the test is always made extremely severe so as to yield quick results.

For example, one of our engineers has devised a "walking machine" to give us a method by which the durability of sole leather can be determined in a few hours time, wearing out the leather by friction in the way you wear it out when walk-
(Continued on page 101)

Another of Our Prize Contests!

*The
Pugilist*



*What Can You Make
of These 14 Pieces?*

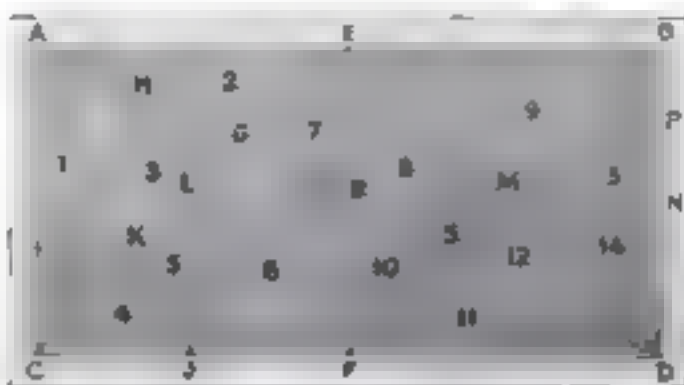
*The
Skater*



POPULAR SCIENCE MONTHLY presents a new Stomachion contest this month. The subject for contestants this time is "sports," and \$100 in cash prizes will be awarded to those readers who submit the best original designs made from the fourteen pieces of the Archimedes puzzle game. The prizes to be awarded are listed herewith.

Two previous contests had as their subjects animal and human figures. In this competition entries may include human figures, animals, or any other features relating distinctly to sports or athletics. One design constitutes an entry, but any contestant may submit as many separate entries as he wishes.

To make the Stomachion, draw a rectangle exactly twice as long as it is wide on a piece of cardboard or thin wood. Then, following the lines of the accompanying diagram, draw EF, AD, CE, ED. Halve the lines



AG, CF, CG, ED, BD, to obtain points H, J, K, M, N. Draw CH, JK, FM, MN. Now bisect AG and BN to locate L and P. Draw JL and MP; the construction is complete. Number the fourteen pieces as

THE PRIZES

First Prize	\$25
Second Prize	15
Third Prize	10
Five Prizes, \$5 each .	25
Ten Prizes, \$2.50 each	25
Total Prizes	\$100

shown, cut them apart, and commence piecing them together.

The pieces may be used in any position desired, even turned over on their reverse faces, provided their form and dimensions are not altered. All fourteen pieces must be used. Each piece must be numbered according to the numbered diagram given on this page. Decisions of the judges will be based on the originality and lifelike character of the figure, and on neatness and skill in presentation. The sole judges in the contest will be the Board of Editors of **POPULAR SCIENCE MONTHLY**, and their decisions will be final. In case of ties, the full amount of the award will be given to each of the tying entrants.

You need not buy **POPULAR SCIENCE MONTHLY** to compete. You can borrow a copy or examine one at any office of **POPULAR SCIENCE MONTHLY** or at public libraries.

All entries must be mailed or delivered not later than March 10th.

New Crime Detector Betrays Heartbeats and Skin Changes

HEARTBEATS magnified a hundred thousand times, and cold sweat betrayed by a flickering beam of light are part of an electric "third degree" that is the latest aid in fixing guilt upon the author of a crime.

When the members of the New York Electrical Society assembled the other night at a meeting in New York City, there was a feeling of tenseness among them. Some one had committed a theft. From the president's coat, hanging in his office, a ten-dollar bank note was missing.

The theft had been carefully planned by Dr. A. P. Link, psychology instructor at New York University, to test his new device. Three volunteers selected from his students left the audience after receiving sealed envelopes, one of which contained instructions to commit the crime. The student who drew

this lot went to the president's office, where he pocketed the crisp bank note.

A burglar alarm sounded. Hastily retreating for fear of real complications, the student found himself face to face with a policeman, who arrested him. Unwarned in advance, the student had all the sensations of a criminal caught in the act. With the other two students,

he returned to the waiting audience.

The three were lined up on the platform, and Dr. Link connected up his wires. Then he proceeded to quiz the suspects. Two gave straightforward answers and showed no excitement. But the third was uneasy. When Dr. Link mentioned "coat," his pounding heartbeats, amplified by the electric stethoscope, were plainly audible, and a moving spot of light on the opposite wall quivered. And when the word "policeman" was shot at him, the magnified sound of his heart was like the beating of a bass drum, while the telltale light beam flashed clear across the screen.

According to Dr. Link, the spot of light was controlled by the lowered electrical resistance of the skin under excitement. Thus and the heartbeats were utterly beyond the control of the subject.



Dr. A. P. Link, New York psychologist and one of his associates, demonstrating his new electrical crime detector. Pounding heartbeats are amplified by the stethoscope.

Our Earth's Changing Face

Sand, rock and water shape new landscapes, sometimes overnight! Your eating habits and your health Some strange reptiles and fish Other fascinating new books

By THOMAS M. JOHNSON

"Romance of Geology"

By Enos A. Mills. Doubleday, Page & Co.

HERE are more thrills than a movie affords! When Mr. Mills strikes rock in his explorations among the mysteries of Earth's changing surface, romance gushes forth. He not only tells a thousand fascinating facts of geology, but he relates his own thrilling experiences and adventures in gathering them.

Once, on the Alaskan coast, he was cast ashore sixty feet above water line by a gigantic wave caused by an iceberg that rose suddenly beneath his boat. On the Painted Desert of Arizona he nearly became a desert fossil himself when a sandstorm almost sealed him for thirty-six hours in a newly formed dune 200 feet long and three to eight deep. On another day, in the same desert, a cloudburst nearly overwhelmed him in a deep black-yellow flood of gravel, sand and boulders borne by the water. But he survived, to write in this book of such wonders as the following:

How the Grand Canyon of the Colorado, "greatest production in Nature yet revealed," has already been dipped into the ocean three times.

How the steadily widening Mississippi delta will soon be as large as a small Balkan state.

How camels and elephants and tigers once roamed these United States.

How the Great Pyramid of Egypt was made of shellfish.

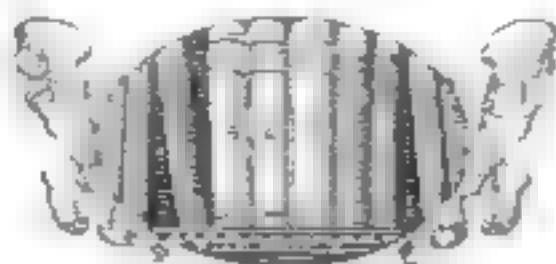
How our continents are sinking at the rate of a foot every 9,000 years.

How the rivers of the United States annually move 515,000,000 tons of solid matter in sediment, and 270,000,000 tons of land surface in solution, back into the waters of the sea.

How enough lime solution from the Kentucky caves is carried annually to the sea to supply the oyster population for three years.

THOSE are only a few of the extraordinary workings of Nature—freakish only to the casual eye but in reality following immutable laws—which Mr. Mills tells. There are the sandstorms of the North Carolina coast, that change the face of Nature and make new landscapes and seascapes. There is the story of how soil is made from solid rock of a million years ago. And there are fascinating tales of those mysterious and famous desert mirages.

A mirage once bent rays of light around a cliff so that Mr. Mills saw a grizzly bear behind the farther end—as he proved by finding the tracks! During a range war in Wyoming, a mirage made a band of cowboy reinforcements seem twenty miles



nearer than they were, and so put the enemy to flight. In fact, Mr. Mills, with pencil and paper, once mapped a mirage, a plateau and peak that did not exist!

"Hygiene, or Disease and Evolution"

By Burton Peter Thom, M. D. Dutton's

"Indigestion, What It Is and How to Prevent It"

By Arthur L. Holland, M. D. Appleton

WILL man some day discover a way to make himself virtually immune to disease, by means, perhaps, of a great "strengthening medicine"? The writer of the first of these books thinks it quite possible, he believes chemotherapy will overcome present obstacles. The physician author of the second book says most people can themselves prevent that bane of many an existence, indigestion.

Right eating and right thinking have most to do with preventing digestive

troubles, Dr. Holland says. If we eat neither too much nor too little, go rather light on meat, and make up in vegetables and fruit, the digestive apparatus of most of us will work all right. Chew well, he says, but not too well, above all, don't "watch your stomach work," don't think of your digestion, and don't decide you "can't eat" certain things harmless to most people, unless your doctor says you really can't. Food phobias are established that way. He recommends rest after meals. Exercises for toning up the muscles are better than drugs, Dr. Holland says, and he gives a set developed especially to aid digestion.

Dr. Thom's book, another of the "Today and Tomorrow" series, predicts new and wonderful discoveries in medicine. Light rays and rays from radioactive substances will soon be used for treatment of diseases other than cancer and tuberculosis, he says, and "it is even possible that by such means all infective diseases will in time be mastered."

Dr. Thom has no apprehensions that when all disease has been eliminated and we become sick no more, man will overpopulate the earth and literally eat his own head off. Improving methods of production, synthetic chemistry, and new utilization of substances present elements, he believes, will furnish man with new foods, new aids to life.

"The New Natural History"

Vol. II. By Prof. J. Arthur Thomson.
G. P. Putnam's Sons

FISH that climb trees and waterfalls. Besides many other strange creatures of the air, earth and water, are met with in this second volume of a series of three. The climbing perch climb palm-tree trees in India, using movable gill covers and spines, and sometimes go for extensive lakes on land. There is a small catfish that has odd, projecting spines with which it can climb waterfalls or dams or even walls down which water is dripping.

Though they have interesting habits, fishes generally have little intelligence, Professor Thomson tells us. In bony fishes the forebrain is poorly developed. They have, however, special senses that tell them when they are nearing rocks or passing tributary streams. They taste food with various parts of their bodies—the catfish, with its tail! They may or may not be deaf, though all have ears—some seem entirely uninterested in noise.

The wisdom of the serpent, we learn, is largely a myth, too. Snakes have good hereditary equipment, but show little adaptability or inventiveness. Here is what the amazing palolo worm does: In the last quarter (Continued on page 164)

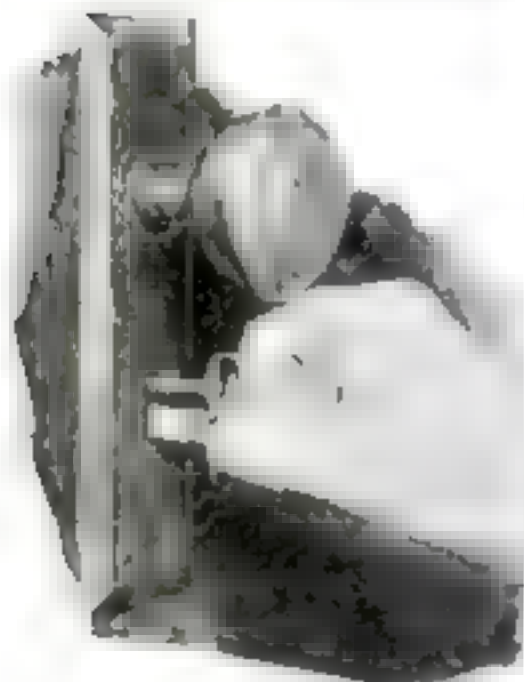


From "Romance of Geology"

Nature's strange handiwork—trees, trimmed and molded into fantastic shapes by wind-blown sand

Handy New Aids

Possibly the smallest washing machine made, this simple device consists of a ten inch handle and a double vacuum cup, which you swirl up and down in the water catching the clothes each time with a churning motion. Just the thing for washing handkerchiefs, silk stockings and lingerie, it keeps the hands out of water. The handle being easily detachable the device takes up little space in the traveling bag.



Lock your door and spring this little brass cup into place in the keyhole, and your home is safer against intruders for the night. It is designed to hold the key in place so that it cannot be turned from the outside or pushed out of the hole. Knobby projections hold it tightly in place.



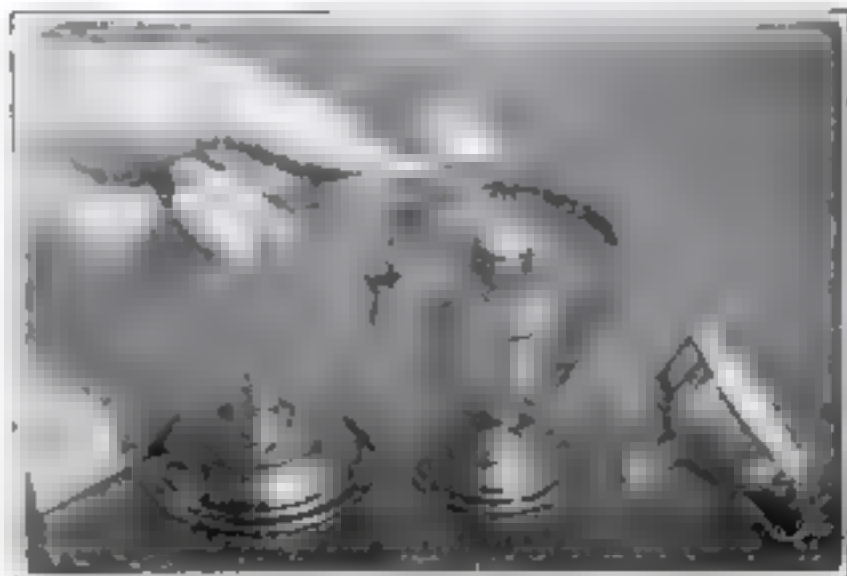
With this rubberized bag attached to your wardrobe, winter clothes can be thoroughly freshened and aired without being taken from the room! The clothes are simply placed in the bag and hung with the air inlet facing an open window. A turn of the switch, and a whirring of fresh breeze tumbles through the bag full of clothes.



This simple jar opener tightens and opens without any adjustments, to fit tops of jars and bottles of any size. It also is used for lifting vacuum jar lids.

Providing the sealed spoon with a small hook at the end of the handle was an English inventor's solution of that vexing problem—how to prevent the spoon from sliding down into the mass of mayonnaise or French dressing. Now, if the spoon slides, it catches on the end of the bowl and stays where it belongs.

Clouds of tobacco fumes in a room where many people are smoking can be cleared away as if by magic with this novel smoke remover according to its inventor. A small chemically treated ring heated by an alcohol flame does the trick, the ring continuing to glow red-hot long after the flame has been extinguished. Aside from its utilitarian purpose, the device is designed to be an attractive table ornament.

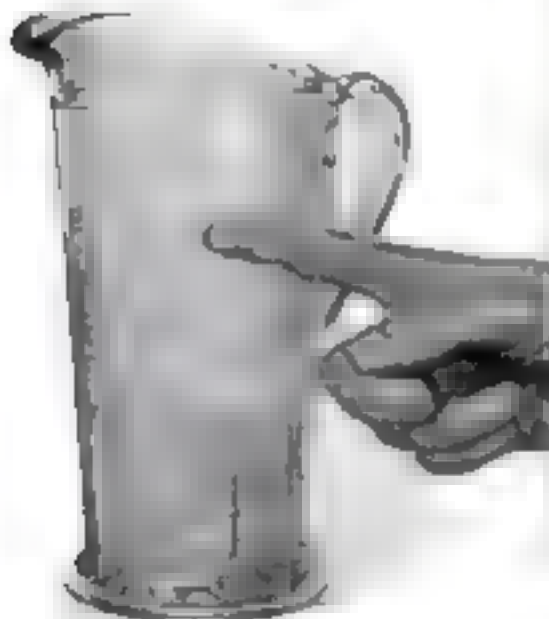


With this spring wound stirrer there's no need to stand over a pot and stir it tediously with a spoon. All that is necessary is to wind a spring, set the device in the saucepan, and forget it until the stirring is done. The device is designed especially for mixing foodstuffs while they're cooking.

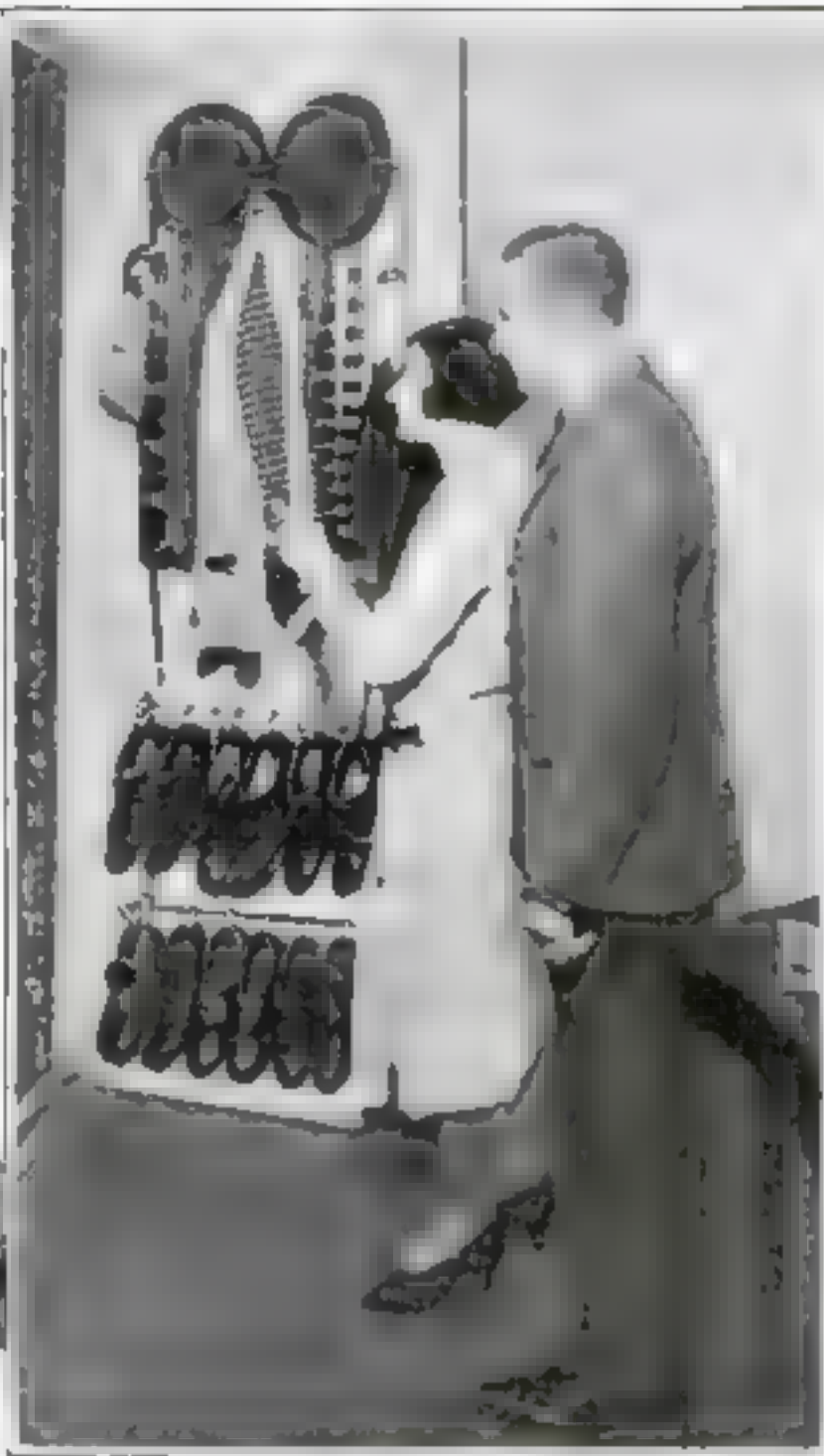
for the Housewife



Ginger ale or any charged beverage is said to be kept fresh and sparkling indefinitely when this little sphonette is substituted for the cap after the bottle is opened. The last drink is then as effervescent as the first—besides which the device aids mixing when other ingredients are added.



Not one scale only, but all the measurements ordinarily required by the cook, are printed on the side of this useful measuring glass. Thus, "1 pound of sugar makes 2 pint" and "Good milk contains 10 percent cream," are among the bits of information printed on it in raised letters, with scales of teaspoonfuls, cupfuls, pounds and ounces.



A closet added to the back of your closet door, this carefully planned rack provides a place for all of a man's wardrobe—curved rods for two hats, a bar for scarfs, ties, trousers hangers for umbrellas, brush, coat, even a shoe rack!



Anything from boiled eggs to hot potatoes can be picked up with these new wire tongs. The rounded jaws, affording a firm grip, the unusually long handle and the built-in spring are convenient and novel features.



Toast cooked over an open fire still vies with electrically made toast for richness of flavor. This modern toasting fork, the telescoping sections of which stretch to form a conveniently long handle, toasts marshmallows or roasts "hot dogs" also.



A soap holder of many uses, the device above grasps a cake of soap at the end of a handle, keeping the hands out of water, or, if soap powder is used, it holds the cloth. It is especially handy for soaping spots on the family wash and swishing it around in a tubful or a pailful of water makes the water soapy without putting the hands into the water.



A remedy for sink stoppages, this device overcomes obstructions in the pipe by air pressure, applied by the handle through a rubber vacuum. A metal disk beneath the handle causes the rubber to grip the sink firmly, forcing all the air down the outlet.



Trousers may be pressed without heat, after the creases have been dampened, by this web frame, which may be suspended from a coat hanger and hung in a closet. Clamped to the frame, the trousers are stretched when the frame is folded, and the two taut bands of webbing remove wrinkles and bagginess.

Sam Loyd Asks—

How Fast *Can* Your Mind Work?

Some New Brain-Teasers to Test Your Resourcefulness and Suggest the Things You Should Be Able to Do Best



Faculty of Visual Analysis

ABOVE is the sign of the cross in its Greek form, composed of five equal squares. Its perfect symmetry makes it peculiarly susceptible of dissection and rearrangement into other forms. It can be converted readily into a square, two smaller crosses, a triangle, trapezoid and so on.

The problem now, fairly difficult for visual analysis, is to divide the cross into three parts which, pieced together, would transform it into a rectangle twice as long as it is wide.

If you can visually convert the cross into a rectangle through the medium of three pieces, your success will betoken natural ability in the science which deals with points, lines, angles, surfaces and solids. Note the time it takes you, and find your rating on page 103.

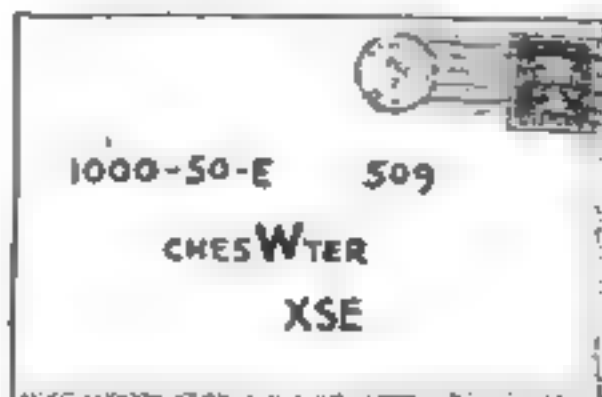


Aptitude for Mental Analysis

"I'M SO glad I met you!" exclaimed Mrs. Smith to Mrs. Brown encountering her friend at the bargain counter. "I want your advice about some dress goods. You see, I can get four yards more of gingham for \$3.40 than I can of voile for \$4.00."

"If you take one, of course you will regret not having selected the other," replied Mrs. Brown. "So I advise you to take ten yards of each, which will cost \$13 for the two pieces."

From this interesting colloquy, you can quickly tell the yard price of gingham and of voile, if you work with facility at figures. Note how long it takes you to solve this problem, and then turn to page 105, where you will find the solution and your rating.



Quickness at Following Clues

POSTAL clerks become expert readers of eccentric handwriting occasionally even of cryptographic inscriptions. For example, here is an envelope addressed in a way to confound the ordinary mortal, but which a post office expert or a detective might decipher in a jiffy.

Can you tell where and to whom that letter ought to go?

Your quickness at solving this should be an index to your mental ingenuity. Time yourself, then turn to page 103.

Fluency in Use of Words

"**W**HILE in San Francisco, some friends took me to a Chinese restaurant to ———— me and ———— chop suey for the first time."

To complete the above sentence, place an appropriate word in the first blank space; then separate that word into four words and in their natural order place them all in the second blank space.

This proves your skill at using words. See how long it takes, then turn to page 103.

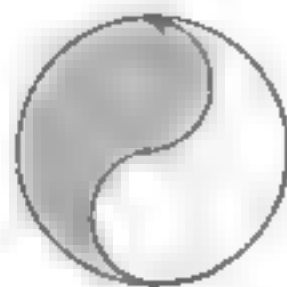


Skill at Rapid Calculating

AMERCHANT sprang a poser on the bank cashier when he gave him a check for \$200 and said:

"Please let me have some one-dollar bills, ten times as many twos as ones; and the balance in five-dollar bills."

It taxed the cashier's skill at rapid calculating, and will yours, too. Time yourself and compare your rating with that on page 105.



Sense of Design and Form

HERE is a companion piece to the Greek cross test. The sign of the Monad, above, is the Oriental symbol of eternity. Like all noted signs and symbols, it is formed on symmetrical lines and lends itself to geometrical analysis. Note that the light and dark sections are of the same shape and size.

Your problem is to halve each of those halves, by drawing across the circle a continuous line that will leave its area composed of four sections, two light and two dark, all of the same shape and size.

To prove that your sense of form and proportion is well developed, time yourself, then turn to page 103 for your rating.



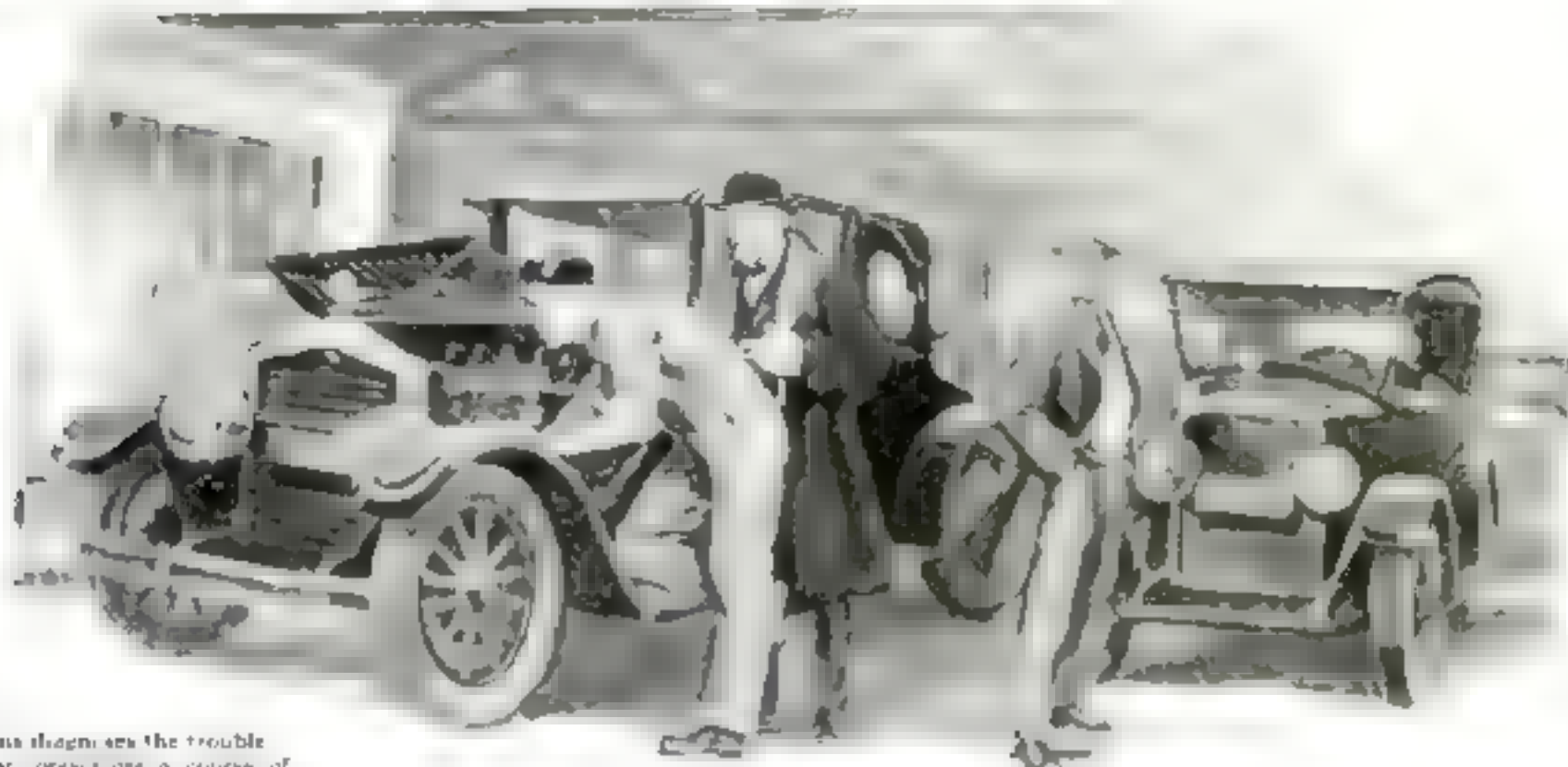
Test of Mathematical Ability

"**H**OW old are you, daddy?"
"Well, let us see. Here's a chance to learn how much arithmetic you are absorbing at school. See how quickly you can figure this out:

"Your mother's age is four times your own, and our three ages combined amount to seventy-six years. When our combined ages amount to eighty-eight years, your mother's age will then be three times yours. Now then, how old is your lady?"

Can you give daddy his information quickly enough to prove that your arithmetical department is running smoothly? Note your time, then turn to page 105.

In suggesting these tests to readers of POPULAR SCIENCE MONTHLY, Sam Loyd, most famous puzzle maker in the world, is offering something more than mere brain-teasers. As tests of your mental abilities, they are a real aid in judging your aptitude for your work.



Gus diagnoses the trouble and prescribes a course of treatment for the doctor's car.

Your Car Is As Old As You Make It

The Hardest Kind of Daily Usage Needn't Age It Unduly If You Will Inspect and Service It Regularly, Says Gus

By MARTIN BUNN

GUS WILSON was exceedingly busy at the Model Garage. His partner, Joe Clark, had been wrestling with the "Bu" for the past week, and having to do two men's work hadn't improved Gus's temper. Consequently the old mechanic's face wrinkled into a scowl when the garage door swung open to admit young Walter Sanson.

"Hello, old socks!" Sanson called out cheerily, struggling to shut the door against the heavy March wind. "Can I get a little free advice today?"

"Huh?" snorted Gus. "This is one of my busy days. I ought to charge you a dollar a word. What do you want to know?"

"Just look over my car and tell me if it needs overhauling. If it does, I want you to do all the hard work and I'll do the easy things myself," suggested Sanson sagely.

"Run the bus in," Gus ordered briefly. Sanson did as directed. Another car that had driven up at that moment followed him in, and the driver, a stranger to Gus, sat behind the wheel watching the repair man as he inspected Sanson's machine.

"How long ago did we overhaul it?" Gus inquired, listening to the motor with critical ear.

"Must be nearly a year and a half now."

"I meant how many miles ago," Gus growled. "Time doesn't cut any ice. It's the number of miles that counts. A car might still be a youngster several years after it left the factory if the owner drove it only a couple of thousand miles during that time. Another bus might be a tottering old wreck in less than a year just because it had been driven several



What Was Wrong With Spratt's Car?

THE name of the winner of the \$25 prize for the most accurate explanation of the trouble with Spratt's car and the best method of curing it, will appear in our next issue. The judges are now busy with the large number of entries received in this contest, which was announced in the December issue.

times past the ten thousand mile mark."

Sanson glanced at his speedometer. "Figuring your way, this boat is about ten thousand miles older since we overhauled it last."

Gus prodded and poked around for several minutes. "She doesn't need overhauling at all," he finally announced. "Everything seems to be tight. It wouldn't do any harm to scrape the carbon and grind the valves. Take it away now and don't bother me any more."

"What can I do for you?" he continued, turning to the disengaged looking occupant of the other car.

"I'm Dr. Holmes of Easton," the stranger began, somewhat pompously. "I was visiting a patient down this way when I heard a peculiar noise in the motor, and I want you to tell me what's the matter."

"Start her up," suggested Gus as he raised the hood. After listening to the motor as it idled, he yanked the throttle open and shut two or three times, short-circuited the spark plugs one after another and finally examined the running gear with extreme care.

"**W**ELL, Dr. Holmes," he said as he straightened up from his inspection. "This car is in bad shape. The motor needs overhauling. The brakes need relining, and there's a whole lot of other things that ought to be attended to. When can you leave it here long enough so I can go over it carefully and make a definite estimate on the cost?"

Dr. Holmes' eyes snapped.

"Stuff and nonsense!" he retorted angrily. "This car was purchased new less than five months ago, and you are attempting to swindle me. Why, I just overheard you tell that young man that his car did not need any work done on it, and his car has gone at least twice as far as mine. If that's the way you do business, I'll take the car elsewhere!" And he started to climb in behind the wheel.

"Just a moment, Doctor," said Gus. "Did you ever hear of premature old age?"

"Premature old age?" repeated Dr. Holmes. "What has that to do with it?"

"A whole lot," Gus asserted. "You know what happens to a young fellow if he stays out late nights and doesn't pay any attention to" (Continued on page 114)

Eight Useful Tips for Your Car

A Homemade Air Valve and Other Devices

Ten Dollars for an Idea!

R. BOETTINGER, of Union City, N. J., won the \$10 prize this month for his suggestion of the homemade air valve (Fig. 3). Each month *POPULAR SCIENCE MONTHLY* awards \$10 in addition to regular space rates to the reader sending in the best idea for motorists. Other published contributions will be paid for at usual rates.

AN AUTOMOBILE valve spring is pretty stiff and requires a lot of energy to compress it. Here is a simple way to compress it and keep it in that position as long as desired without wearing out your muscles. As shown in Fig. 2, the bench vise supplies the leverage needed to compress the spring with great ease, and the small metal clip serves to keep it compressed. The spring should be set in the vise jaws to a point slightly past the center line of the spring, so that it will not bend out sideways. Then screw up the vise and slide the spring from the vise into the clip. The clip can be cut out of sheet metal and bent into shape. The handle is not absolutely necessary, but is convenient.

Better Light in the Rain

YOU probably have noticed that your headlights do not seem to give nearly so much light when you are driving in the rain as on a dry night. This loss is due to the diffusion of the rain drops that collect on the glass. Each one acts like a tiny lens, and the rays that should be directed toward the road in front of you are refracted off in every direction except the right one. If you will wipe the glass of the headlights with a rag moistened with ordinary glycerin (Fig. 1), the rain will form a smooth layer.

Homemade Air Valve

A PROPERLY adjusted spring controlled air valve in the manifold between the carburetor and the cylinder head will materially increase your gasoline mileage. Fig. 3 shows how to make such a device from standard parts. An ordinary solderless union tee of the type used in gasoline lines forms the body. A light spring and a ball bearing of suitable size are placed in each end of the tee under the nut, which

can be turned to adjust the tension of the spring. A flat spring screwed to the tee will keep the nuts from turning.

More Mileage on Long Runs

IF YOUR car is fitted with an automatic windshield wiper of the vacuum operated type, you can fit an auxiliary air inlet to get more mileage out of your gasoline on long runs. Connect a petcock in the rubber hose line leading to the wiper and on long runs you can pull the end of the hose off the wiper and allow extra air into the manifold by adjusting the petcock. Fig. 7 shows the arrangement.

Ingenious Trouble Light

A WOODEN clip of the type shown in Fig. 5 makes an excellent base for a trouble light. A socket of standard type should be attached to the clip as indicated. The clip will hold on to any small round object, such as a wire, or on to the edge of a sheet metal part.

Universal Wheel Puller

ANY type of wheel that is stuck on the end of a taper axle, regardless of the size of the threaded hub, can be removed with the wheel puller shown in Fig. 4. A section of 2 by 4 inch lumber is drilled with a hole at each end and in the center. Heavy rods are forged into the shape of a hook at one end and threaded at the other. A heavy bolt is pointed at one end for use in the center.

Holds Carriage Bolts

CARRIAGE bolts that have worn loose in the wood are not easy to tighten. Sheet metal lock washers of the type shown in Fig. 6 will hold the bolt stationary while the nut is being set up tight. A pyramidal point should be ground on the end of the punch so that a square hole can be punched in the center of the washer. Where there is plenty space, a piece of sheet steel can be used with the corners turned down to grip the wood.

To Stop Hood Rattling

THE fastening arrangements on the hood of the modern automobile usually hold it tight enough to prevent rattles, but when the fastenings wear, annoying rattles sometimes develop. A way to eliminate them is shown in Fig. 6. Take a piece of small size garden hose the length of the hood, split it with a knife and slip it over the lower edge of the hood.



Fig. 2. A simple way to increase light at night



Fig. 3. Above, shows how to make an automatic air valve to increase your gas mileage

Fig. 4 (left) Universal puller for auto wheels



Fig. 5 (left) Wooden clip mount for trouble light

Fig. 6 (right) Simple anti-rattler for hood

Fig. 7: Simple arrangement to obtain extra mileage on long runs

Fig. 8: Sheet metal washers will hold loose carriage bolts

Fig. 9: To stop hood rattling

Fig. 10: To stop hood rattling

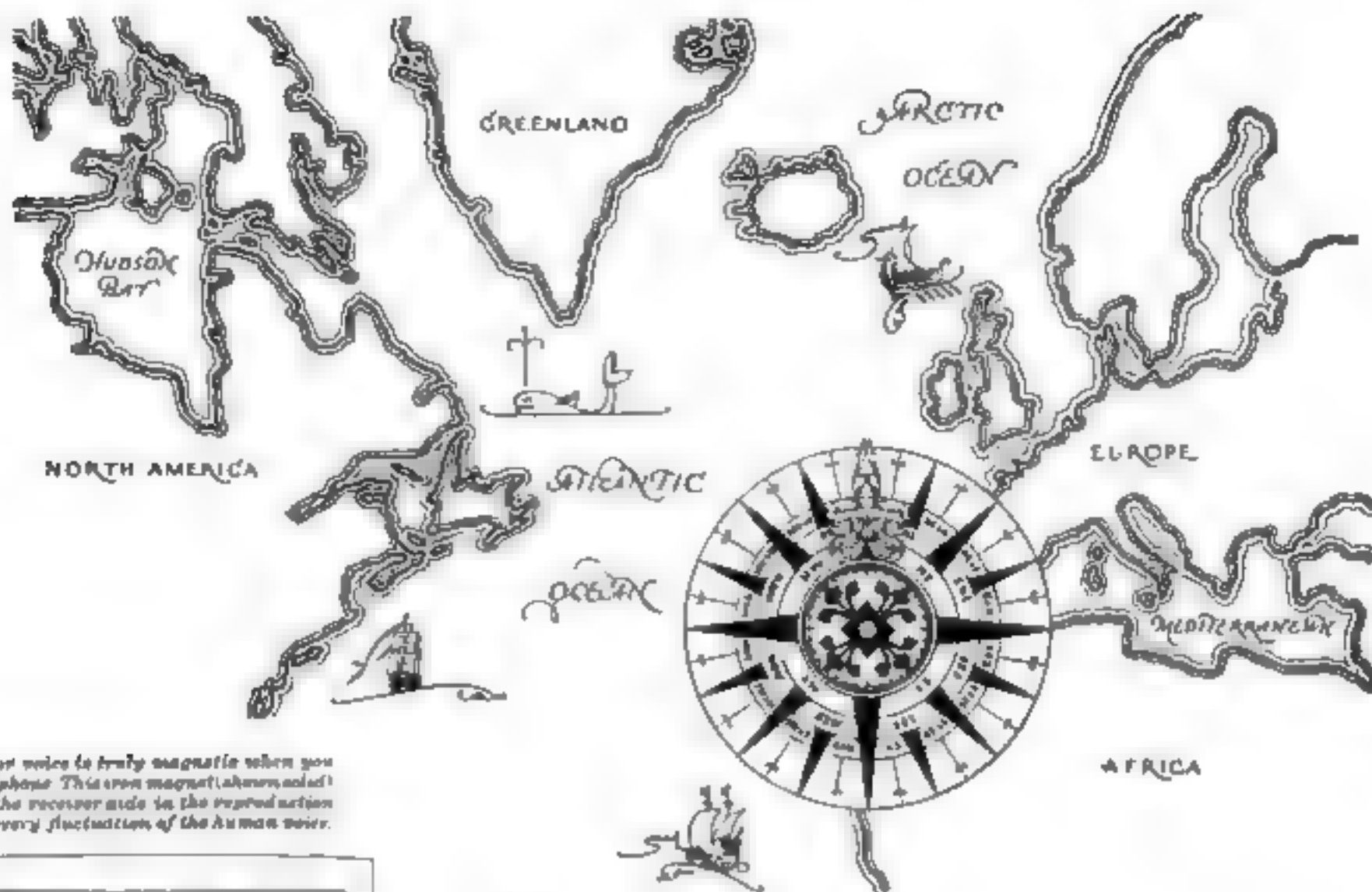
Fig. 11: To stop hood rattling

Fig. 12: To stop hood rattling

Fig. 13: To stop hood rattling

Fig. 14: To stop hood rattling

Fig. 15: To stop hood rattling



Your voice is truly magnetic when you telephone. This iron magnet (shown inside) in the receiver aids in the reproduction of every fluctuation of the human voice.

Iron^{*}-the Magnet aid to voyagers and voices

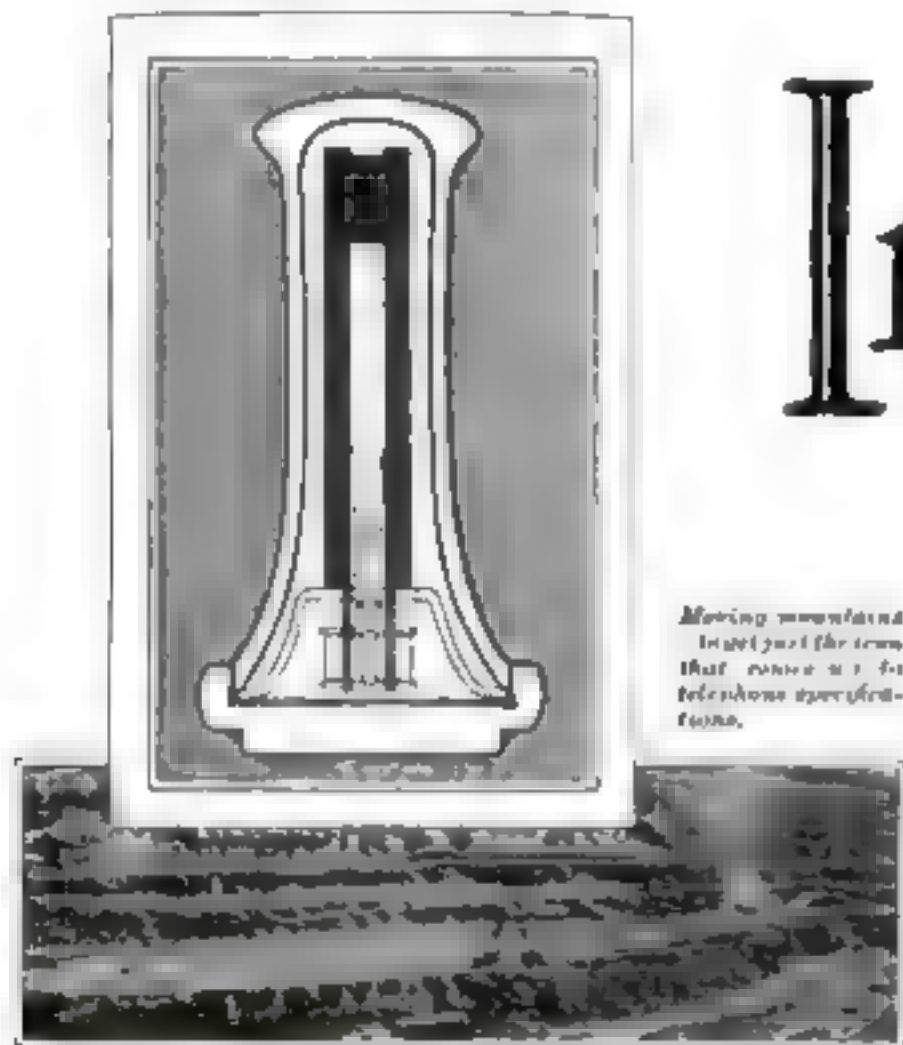
WE all know that the magnetic property of iron is put to use in the compass—an indispensable aid to the traveler. This same property is at the heart of your telephone instrument, for there is a magnet in the receiver which aids the voice on its journey direct to the ear.

But there is iron and iron—and just one kind that qualifies for this important part of telephone making. To find that iron is a Western Electric responsibility—just as it is our care to seek out in the ends of the earth the right quality for all the other eighteen materials that go into this instrument.

Out of such tested materials is produced economically and accurately the delicate yet durable instrument that contributes its share to your good telephone service.

^{*} Part of a series
on new materials.

Moving magnet
helps just the iron
that comes out in
telephone specifications.

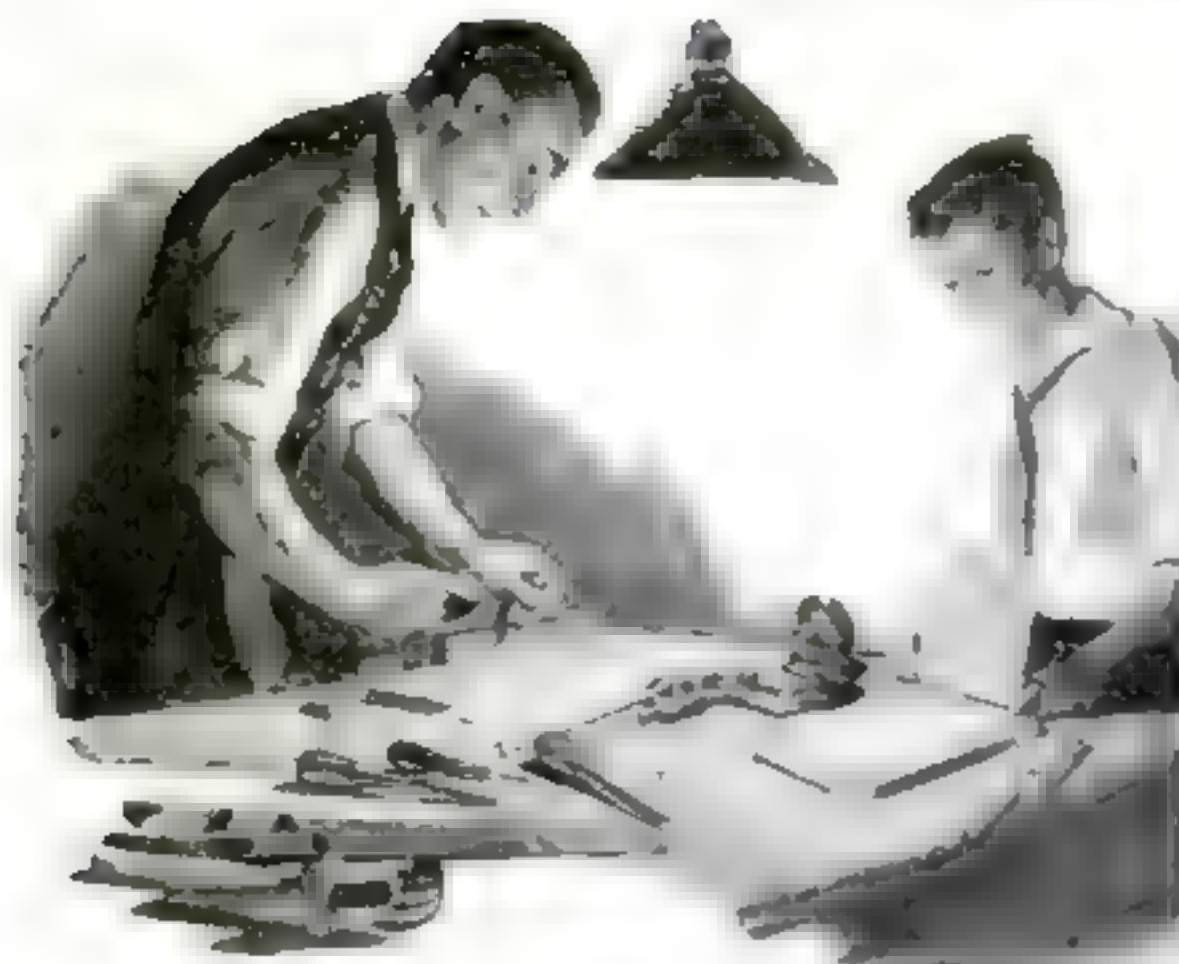


Back of
your
telephone

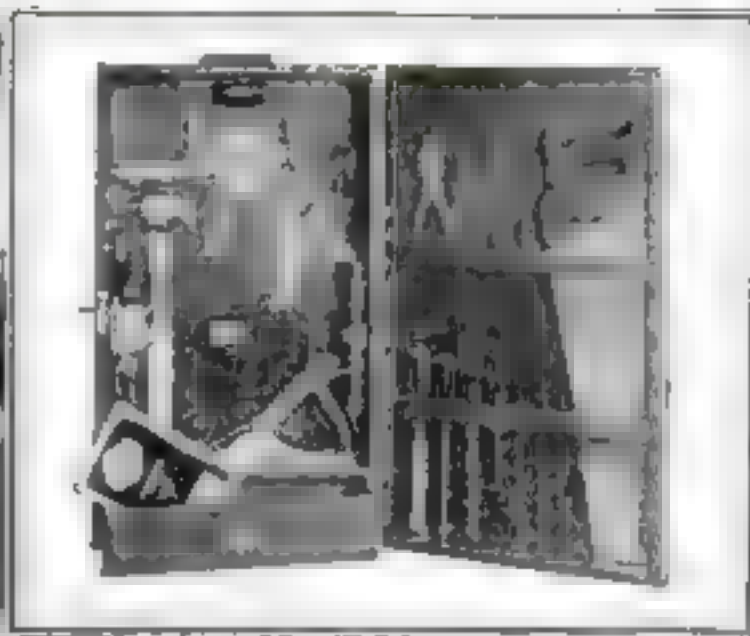
"From the Far Corners of the Earth" is the geography of your telephone. For your copy address Western Electric, 139 Broadway, New York.

Western Electric

SINCE 1882 MANUFACTURERS FOR THE BELL SYSTEM



Buy separately or in assortments



Are your books in order?

YOU keep most of your books in book cases. But how about those volumes which are in active use? Are they scattered about? A table book rack will keep them orderly and always at hand.

Stanley Plan No. 1-E will show you how to make one. All details of construction are clearly given. Sent on receipt of 10c.



Of course you realize the importance of using good tools. The amateur user needs good tools even more than the professional. Nothing is more discouraging than to have your work go wrong when you are in the midst of an interesting job. Most carpenters use Stanley Tools because they know from first-hand experience that the Stanley name assures correct design,

right "feel," and durability. And Stanley Tools are first choice in thousands of manual training classes.

You can buy Stanley Tools separately and so collect your own set. For your convenience in buying there are also complete sets of Stanley Tools in chests at a wide variety of prices from \$15 to \$96. Or there are assortments in strong cardboard boxes containing directions for making your own tool chest. Price \$2 15 to \$20.



Your hardware dealer has Plan No. 1-E as well as other Stanley Plans for making useful articles, or he can get them for you. The plans cost only 10c each. Ask him also for Catalogue No. 34-E which shows the most complete line of woodworking tools on the market. It is free. If he cannot supply you write to The Stanley Works, New Britain, Conn.



The best tools are the cheapest to use
Ask your hardware dealer



STANLEY TOOLS



The Home Workshop

Arthur Wakeling, Editor

A Welsh Dresser

THES E are fortunate days for the amateur woodworker. Plain and homely woods like pine and maple—those that the home mechanic can obtain and use most easily—are now held in high esteem; they have returned to favor with the simple and beautiful early American styles of furniture.

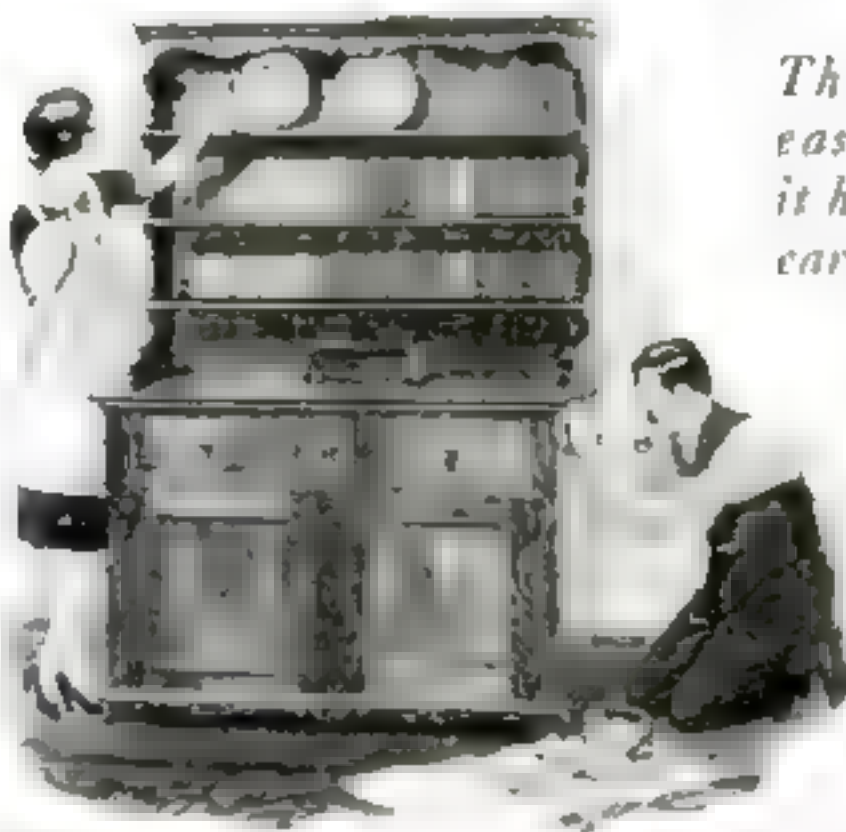
You might hesitate to begin building a mahogany buffet for your dining room in the style of Chippendale or Sheraton, but you need have no doubts in undertaking the construction of the pine dresser often called a Welsh dresser illustrated at the right. While it is a piece of the finest appearance when finished, the work involved is relatively simple.

Straightaway carpentry rather than fine joinery is required. There are no difficult joints to be made. The parts are assembled almost wholly with plain butt joints and held with glue, nails or screws. Even the door frames can be nailed together. The panels are not set in grooves; they are held in their frames by stick moldings, which serve the dual purpose of improving the appearance of the dresser and making the construction easier for the beginner.

FAR as the idea of simplicity has been carried in this design, no crudeness is visible when the dresser is completed. No one but yourself will know that mortise and tenon joints, dovetails, dadoes, and those refined methods of construction that delight the cabinetmaker but somewhat appal the beginner have been omitted. On the other hand, if you have had experience in the more elaborate forms of joinery, by all means use them; they will make the piece very much better and can be used in place of the more elementary methods suggested.

"But why should I build a Welsh dresser when I have a perfectly good buffet?" you may ask.

Because they seem to have a charm that is lacking in the common commercial types of buffet. If you had visited one of the recent exhibitions of modern industrial art at the Metropolitan Museum of



Completed, the dresser has Colonial charm.

This piece is very easy to build and it has the charm of early American pine

Art in New York, you would have been struck by the beauty of the plate dressers on view there. One of these is illustrated on page 88. Such pieces are representative of the finest design and highest craftsmanship of furniture manufacturers whose work is sought by interior decorators and the more discriminating purchasers of good furniture. The very fact that they were admitted to the Metropolitan Museum indicates their high standing. You cannot, perhaps, turn out quite so finished

pieces as these, but you can make a dresser of fine appearance that will convey the same feeling of good taste and beauty.

In the drawing (Continued on page 88)

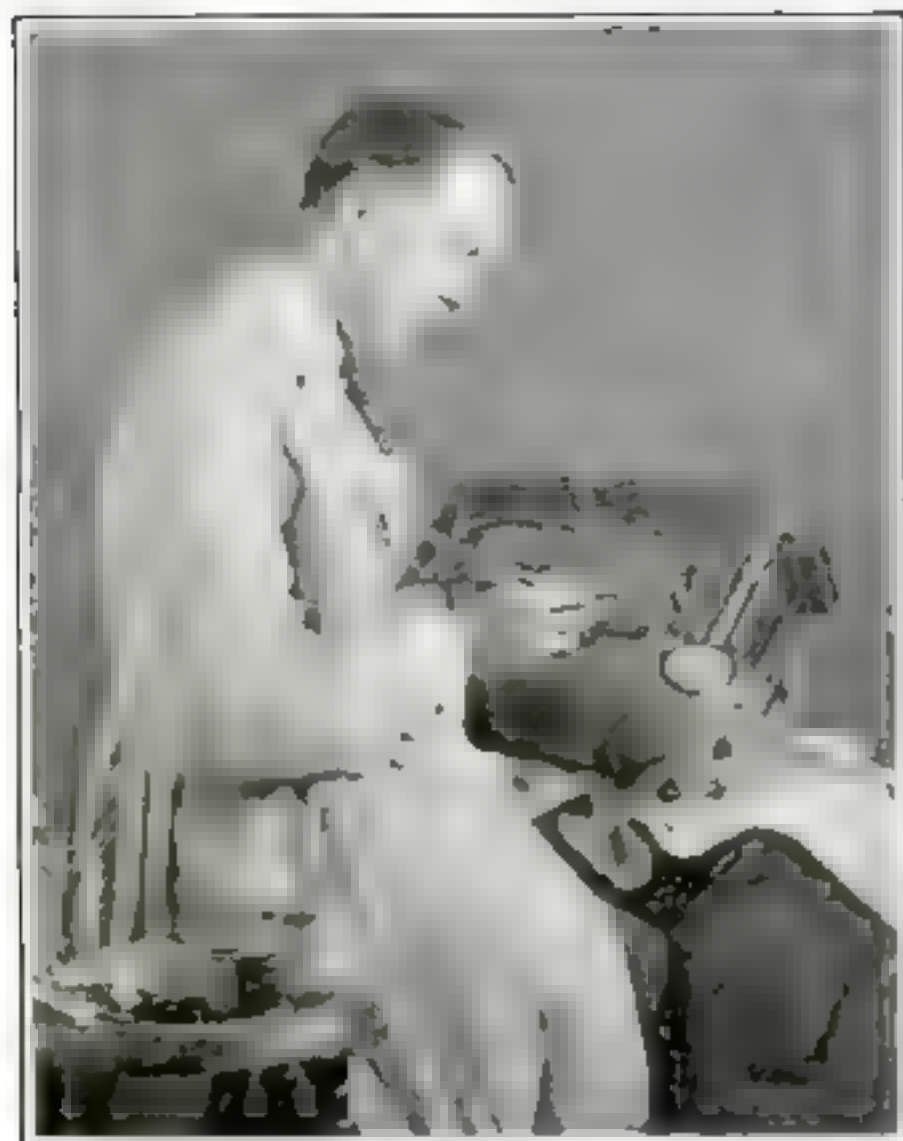
Art in New York, you would have been struck by the beauty of the plate dressers on view there. One of these is illustrated on page 88. Such pieces are representa-



Front and end views of the dresser. Drawings on a larger scale, together with various full size details and a bill of materials, are contained in our Blueprint No. 60 (See page 105)

He Built a Little CIRCUS—

How Imagination and Cigar Boxes Became a Complete Working Model of a "Big Top"



Joe Taggart putting the finishing touches on one of his glittering circus wagons. It is complete even to wheel brakes and loading ring

INTO the life of almost every normal boy comes the urge to be a clown, or trapeze performer, or ringmaster, or lion tamer. Each spring this fever rages throughout our fair land with consuming fire.

Most of us, compelled by the pale commonplace of humdrum life, outgrow this fierce call of the wild, except when the circus comes to town. But now and then a boy who cannot be a circus man and own a real, full-sized circus and is not content to play circus in his father's barn, creates a tiny model of "The Greatest Show on Earth" and thereby gives employment to an active, inventive mind. Joe Taggart, of Rockford, Ill., is one of these.

Joe is in his twenty-sixth year. He began building toy circuses in his twelfth year. Now he is king of the miniature showmen. He has harnessed his imagination to actuality.

If you chance to visit the comfortable Taggart home and it is a day when the cruse-clipped grass is green, and you wander behind the Taggart garage, there you will find the "Taggart Combined Shows" pitched, and doing business in all their gattering glory. You will also find its proprietor displaying his aggregation of wonders to a host of admiring neighbors.

"My first 'big top,'" he explains, "was pitched on our laundry table. My first baggage wagons and cages were cigar boxes covered by bright colored paper and mounted on roller skate wheels. My first

animals were gophers, which died from self-starvation or gnawed their way to freedom, and a small garter snake, released at Mother's command. My first lighting system was a set of gasoline torches operated by pressure.

"I was not discouraged by my first fire—for had not the great Barnum lost most of his show by the burning of his winter quarters long before I was born? But Mother banished me and my paraphernalia to the outer world. Then I abandoned the roller skates, put real

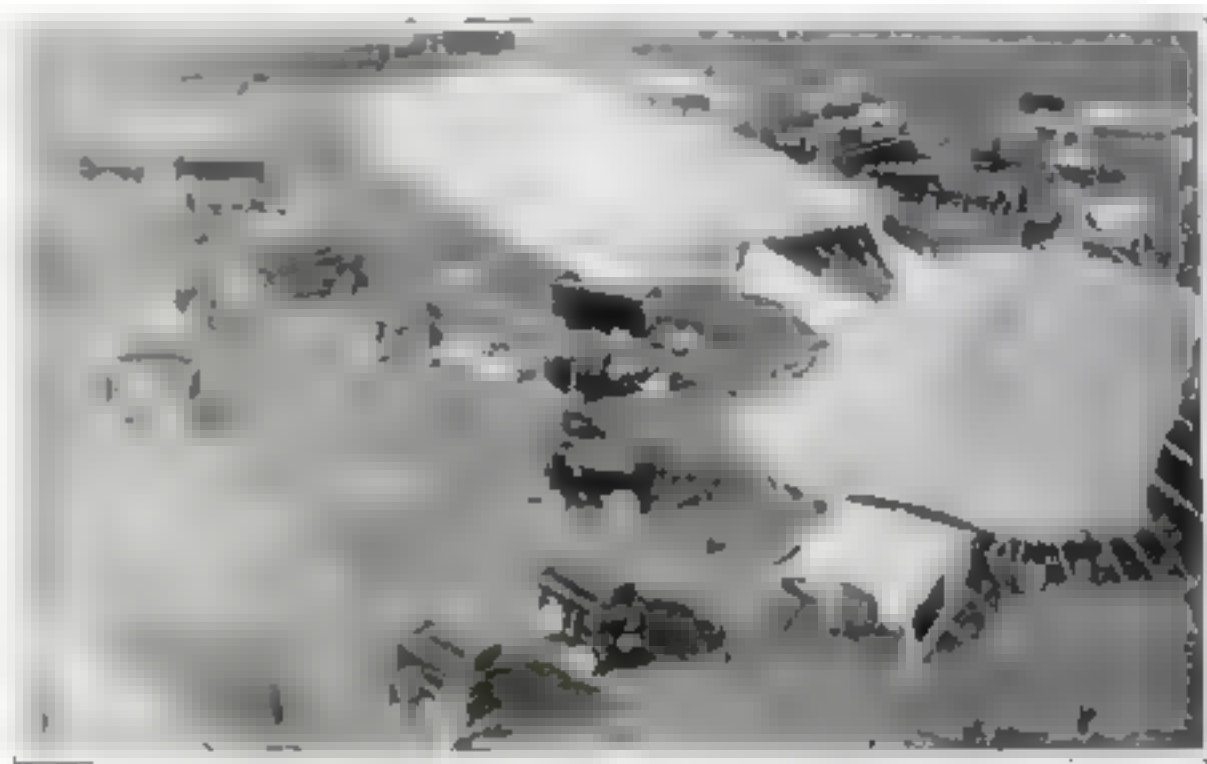
wheels under starch boxes and began to approach my ideal. The wheels were made from straight-grained soft pine lumber an inch thick, turned on a lathe, with sixteen jig-sawed spokes, and copper tubing driven through each hub for a bushing. That was a difficult part of the job, for the bushing had to be tight and many wheels were split. Once over this hurdle, I baked the wheels to drive out all moisture and prevent later warping, coated them with shellac and thick white

paint—three coats—and varnish. This made them almost weatherproof even before I had added the typical circus 'sunburst' design without which no circus parade wagon is complete.

"Having gotten this far, I began to build cage wagon bodies in the orthodox fashion with iron bars, shutter windows and detachable sides, heavy, carved corner posts, decorative 'sunboards' for the top; everything decorated in red paint and gold leaf, with practical wheel brakes and brake or drag shoes such as you see hanging beneath every well built circus wagon; removable wagon tongue, body pole, whiffletrees. I have even added to each wagon a loading ring. A loading ring is the one near the front of the wagon into which the 'hook rope' is fastened before the wagon is drawn up the 'loading runs' by the 'pull up' team each night, or lowered down the loading runs each morning after the hook rope is snubbed around an iron capstan fastened to one of the flat cars.

"**T**HE wagons came first in my problem because a circus is nearly always in motion. If you can't 'move the show' the show will go broke. It has to be moved on and off the 'lot' or circus ground. It also has to be moved from town to town. I covered that last feature by building Pullmans and flat cars.

"One Pullman is without vestibules, which is strictly in circus form; another



A general view of the circus showing the "front gate" or main entrance, the menagerie tent, which is the nearest one, and the "big top." Two ticket wagons stand beside the "gate"

You Can Do It, Too

By

EARL CHAPIN MAY



Standing in front of the menagerie tent are the animal cages and at the left is the banner line, each banner a perfect miniature

Here is what the circus people call the "cookhouse" with its various wagons

has vestibules for the boxes to ride in—fancy stuff, you see. All my Pullmans have built-in berths, circus fashion. Circus berths are always completely made up. At least the upper berths are never closed as they are in ordinary passenger trains.

"Each of my Pullmans is mounted on regular six-wheeled trucks, although my other circus cars have four-wheeled trucks only. The Pullmans are electric lighted and there is bedding for each berth. At one end of my circus train are the heavy runs or inclined planes over which the wagons are rolled on and off the 'flats.' All of the cars have automatic couplings, air hose, brakes, chains and complete workable iron detail."

AND then the casual visitor wanders through a maze of menagerie tents, side show tents with flaming banners depicting the fat boy, the tattooed lady and other wonders, horse tents and small wooden houses latched to canvas managers, cook tents with tables set for the hungry hordes of working people and artists, a

wee blacksmith tent with blazing forges, ringing anvils and enough tools to keep three Lilliputian blacksmiths busy, candy stands, hot dog stands, ticket booths, each protected by a red umbrella, four ticket wagons all trimmed in gold, electrically lighted, with oval doors and glass windows.

A peek under the billowing dome of the "big top," fifteen feet long by eight feet wide, through a conveniently dropped side wall, reveals a hundred large and small supporting poles and miniature "blue" seats and well backed "reserves," safely supported by jacks and stringers and capable of accommodating ten thousand Lilliputian circus fans. It also reveals a wealth of aerial apparatus—nets, trapezes, rings for gymnastic work, three complete sets of aerial rigging for the flying return acts, three curb rings and a huppelone track, a steel arena for performing animals over which hangs a cone net, two stages and a mighty company of acrobats, clowns, acrobats, knights and ladies in "old English" costumes going through the

evolutions of the "grand entry." There are also beautiful equestrian cowboys and cowgirls, a burlesque police patrol, and a bandstand.

There is an infinite detail about the tiny Taggart Shows. There are two generator wagons, each with miniature but powerful beacons, run at high speed by toy electric motors which look like dynamos, driven by dummy six-cylinder gasoline engines. There is a stake driver, an accurate replica of the real machine, operating on the punnover principle, a water tank, a caltrop and a wee motor truck to haul the heavier wagons. The tents, of light canvas are made "weather worn" by judicious use of oil and sand, and ribbed with rope to prevent tearing in stormy weather. These tents are pulled to the "peaks" of the center poles by regulation block and tackle. It is all very lifelike and realistic.

Do you peer under the menagerie tent, you see a herd of elephants safely picketed. In the ~~four~~ pens are monkeys, bears, lions and other wild animals. A long-necked giraffe is at ease in its carefully padded cage. "Sacred" cows and other "led" animals are tethered for to admire and for to see. The exhibit is uncannily like the real thing.

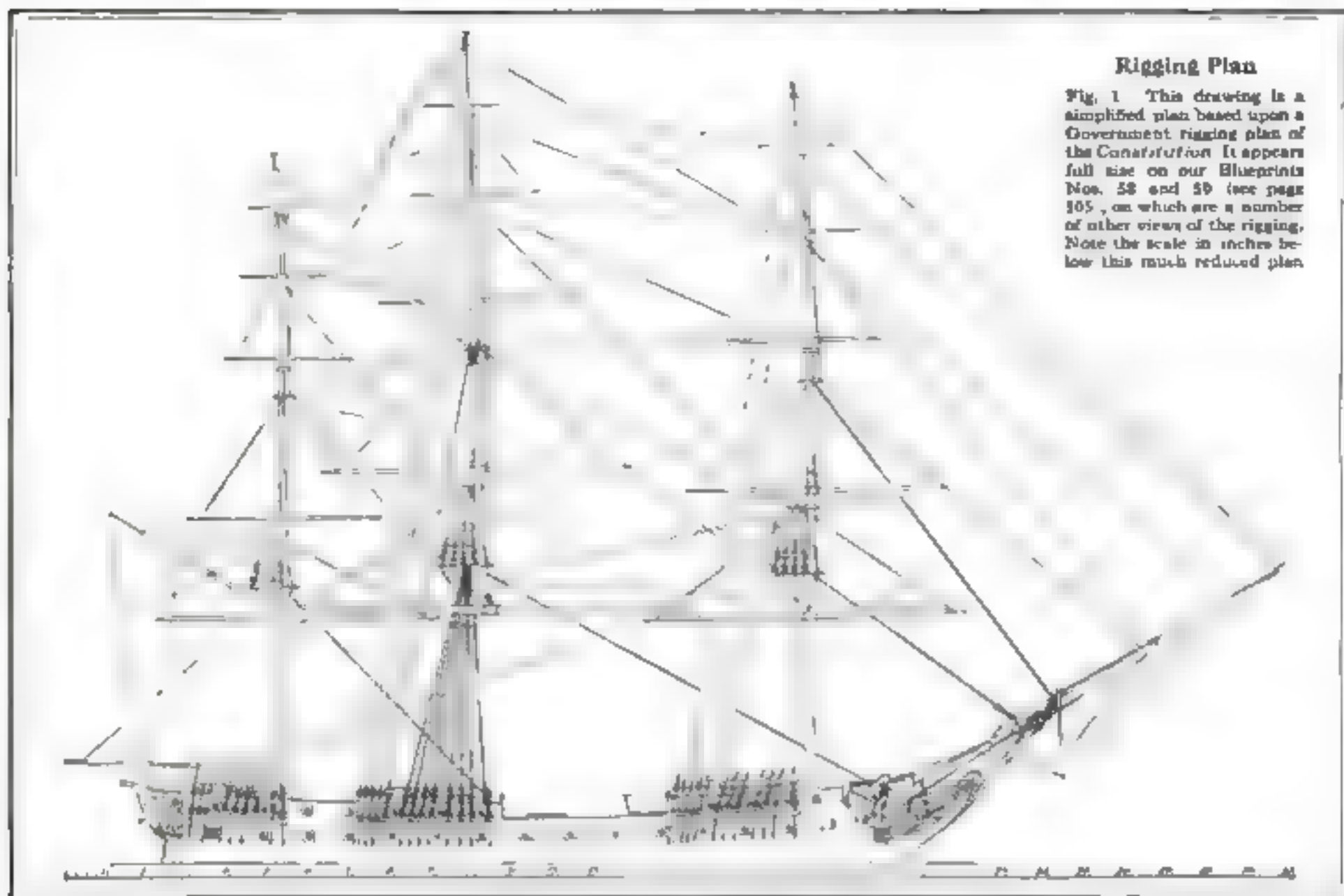
Around the dressing tents and padroom are washboards and washtubs. Gay circus costumes hang drying, on convenient guy lines. Actors lounge in camp chairs, as is their wait, awaiting their turns in the "big top." Wardrobe and property men are bustling spangled garments and trappings out of red and gold wardrobe wagons.

BUT it is in the mechanical part of his counterpart of the "Greatest Show on Earth" that Joe Taggart proves himself a realist in the land of make-believe. He loads his show with that precision which couples form and efficiency in the public mind. Each wagon is numbered by departments. The ten wagons in the cookhouse department, which is department No. 1, are numbered "11," "12," etc. Into them go the tiny tents, steam kettles, tablecloths and dishes. Each wagon in the horse and stock department, which is department No. 2, is numbered "21," "22," etc. Joe's passion for detail is carried to numbering each manger for each horse. But the lighting department awakens, perhaps, the most enthusiasm.

"When I had (Continued on page 112)



Loading the show on the train, which has both Pullmans and "flats" and is equipped with automatic couplings, air hose and brakes. You can see the torches, if you look sharp



Rigging Plan

Fig. 1 This drawing is a simplified plan based upon a Government rigging plan of the *Constitution*. It appears full size on our Blueprints Nos. 58 and 59 (see page 105), on which are a number of other views of the rigging. Note the scale in inches below this much reduced plan.

"Old Ironsides" in Miniature

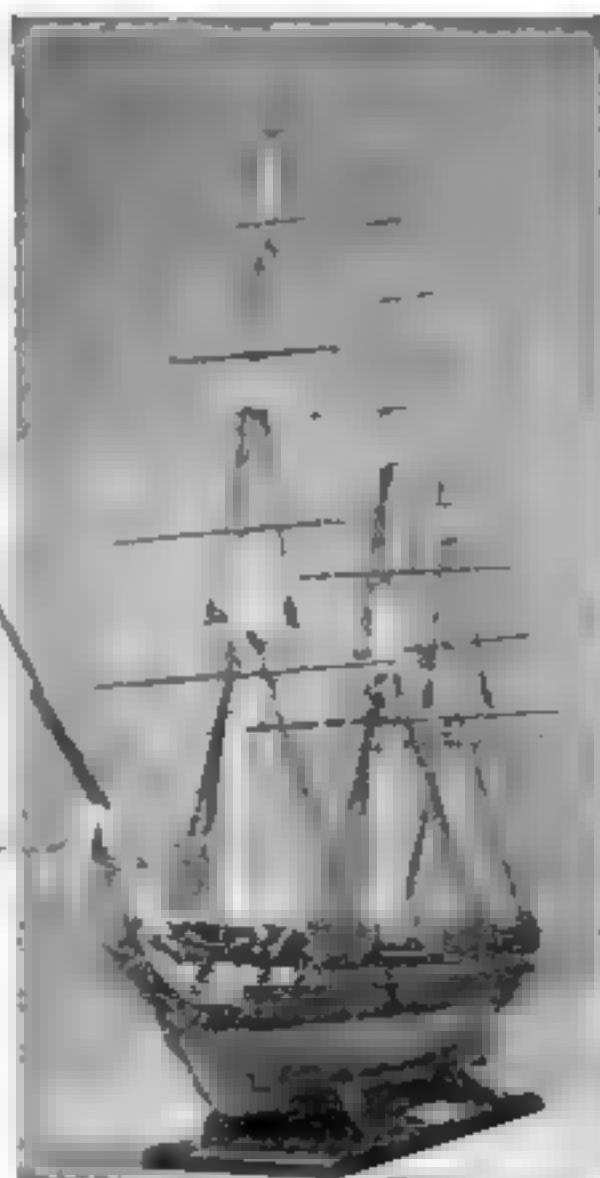
By
CAPT. E. A. McCANN

JUST as the famous old frigate *Constitution* lies in the Charlestown (Boston) Navy Yard awaiting reconstruction this spring, countless little models of her are lying in the miniature dockyards of those readers of *POPULAR SCIENCE MONTHLY* who have been following this series of articles.

These miniature men-o'-war by this time are complete as to hull and fittings; the lowermasts and bowsprits are shpped; and the fittings are ready for installation.

If by any chance you missed the preceding articles in January and February, yet would like to build a model of "Old Ironsides," you can do so by sending for Blueprints Nos. 57, 58 and 59, listed on page 103. These contain full size drawings of the hull, fittings and rigging and a list of materials—everything a reasonably ingenious man needs to know about the construction of the model.

With the bowsprit in place, we now add the bowsprit shrouds (Figs. 1 and 4). These as well as the bobstays and all the lower rigging—the lower and topmast



How to Complete Your Model of the Historic Frigate *CONSTITUTION*

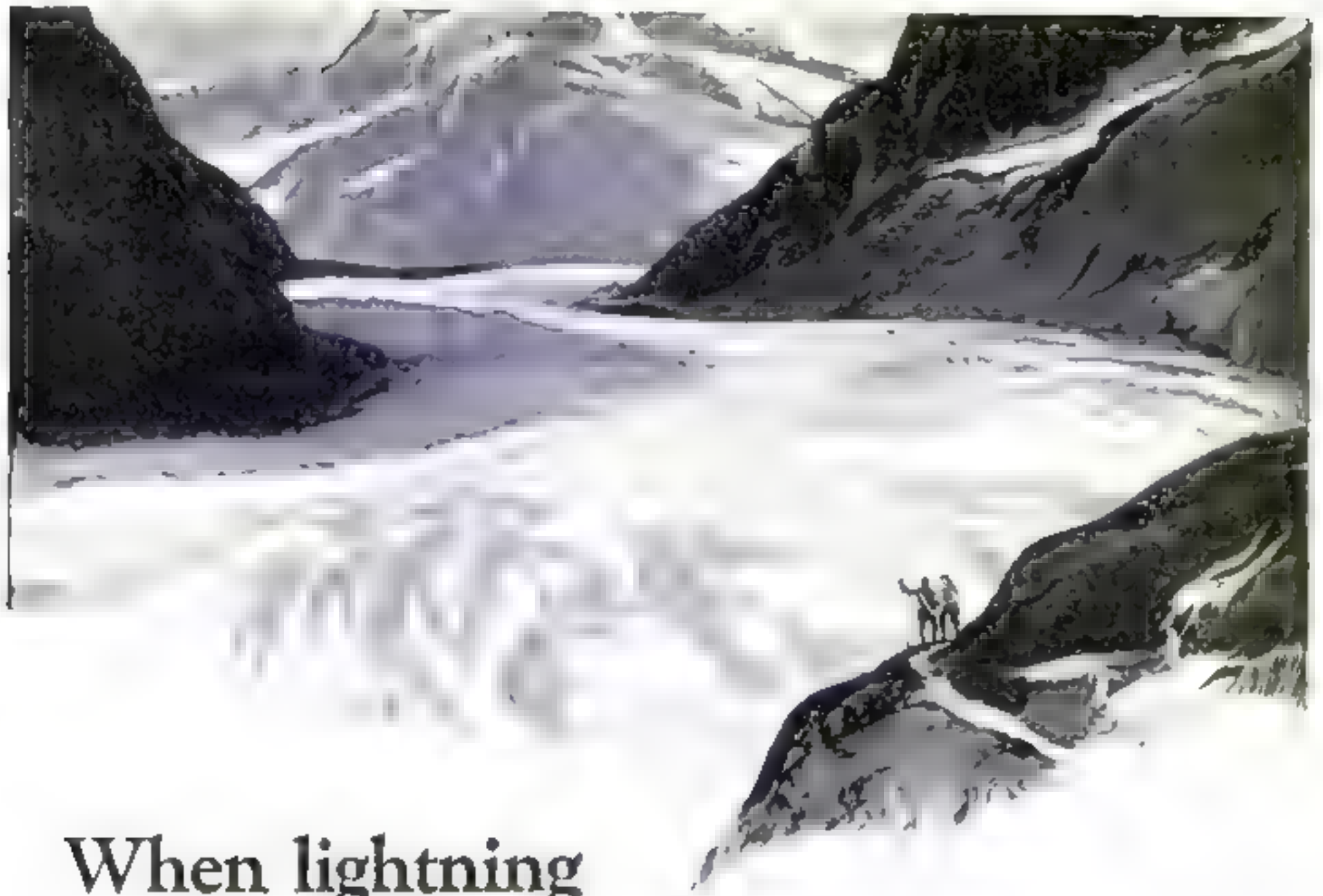
stays and backstays—should be of a good quality cord, such as sixteen-thread linen fishing cord, which is about as thick as ten sheets of this magazine. Dye it black.

The bowsprit shrouds are seized (bound) to staples in the hull just forward of the first guns; the other ends have deadeyes seized in. Through these deadeyes and those at the sides of the bowsprit, lanyards are rove by which they are drawn tight, with the bowsprit fairly in line with the keel.

The two bobstays are seized to the holes in the cutwater and similarly drawn tight to the deadeyes under the sprit.

Now we proceed to stay the masts in position. The main is, perhaps, the best to start with. Place the top in position, then bring a cord down from the masthead on either side, tying the ends to gun ports (Fig. 3). Have the masthead truly amidships. Bring another cord from the same place around beneath the bowsprit to preserve the fore-and-aft angle of five degrees. These temporary stays should be applied to each mast, before setting up the rigging.

It will now be necessary to make a number of dead- (Continued on page 82)



When lightning seems as slow as a glacier



Upon such scientific achievements as the cathode ray oscillograph—lightning's camera—is the confidence in General Electric equipment founded. Many of these achievements are better known. The modern developments in x-ray, the service that has made MAZDA lamps a staple of commerce, the modern small motor that has taken drudgery out of household work—these are some of the milestones of progress.

It is easy to photograph a glacier because it moves but a few feet a year. But to photograph the effects of lightning on electric circuits—effects that come and go in millionths of a second—would seem impossible. Yet there is a man-made machine operated in the laboratories of the General Electric Company that does just this. It makes even lightning seem slow.

In the machine a swift-moving stream of electrons flashes across a photographic film. It dances out of its path when the freakish currents, caused by lightning, surge along the wires. There

on the film is the footprint of lightning.

It has made possible a study of the working of a lightning arrester—the ingenious device that protects the costly equipment of the power house as well as the very lights in your home.

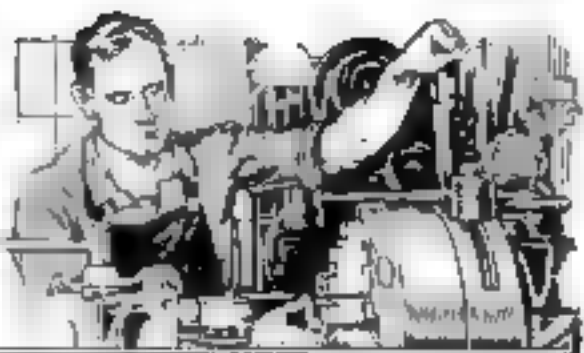


Above is one of the photographs—oscillograms they are called. The jagged curve is produced by the lightning. The surge traveled at the rate of thirty miles a second but it was recorded and in the amazingly short time of one-millionth of a second.

GENERAL ELECTRIC

Better Shop Methods

How Expert Mechanics Save Time and Labor



Ways to Save Money in Your Shop

Improved Segmental Grinding Wheel—Indexing Chuck for Turret Lathe—Surface Grinder—Electric Hand Saw—Other New Ideas

By JAMES ELLIS

BASCOM'S door with "Superintendent" painted across it, was usually open, so it happened that as he closed his little black notebook, he looked up to see his friend, Henry Davis, standing before him.

"Selling lots of steel these days, Henry?" Bascom asked.

"Why, of course!" Davis laughed, in mock astonishment at the query. "All the big fellows use my steel."

"Well, if you don't watch out, Henry, you won't be able to sell steel many more years," Bascom retorted facetiously. "With the grinding machines coming into use as they are, we will be grinding everything before long. I want to tell you about the latest we have in that line. You remember when you were here last I showed you that big new surface grinder that we put in to finish some machine bases?"

Davis nodded quickly.

Fig. 1 Motor driven hand saw with a telescopic guard for safety



This particular one had six segments held in with as many bolts and clamps.

"These segments are arranged to be clamped solidly against the inside of the chuck rim," Bascom explained, "and are driven by solid lugs so that friction is not depended upon to hold them in place."

"Something else—" Bascom continued. "You know that grinding wheels are fragile, and can be crushed or broken, so the makers of this chuck have provided some bronze rockers that will distribute the pressure of the clamps over several points on the segment; that prevents breakage. The bolts are made of stainless steel, so they, too, will not rust."

Davis slapped Mr. Bascom on the shoulder and exclaimed: "I knew we'd get you! We make the stainless steel for bolts such as these, so even here in your grinding you can't get away from us!"

"**O**F COURSE we do use some tool steel," Bascom admitted with a smile, "otherwise you would forget us. Let me show you a new tool that we have put in that may use a lot of it. I do not mean that it will waste steel, but it is big enough and strong enough to break a good husky tool."

Some distance away was a new planer (Fig. 3), and the two looked at it for a while.

"Remember the ancient planer in the shop where we worked in the old days?" Bascom asked. "You can easily see how far we have come along in the matter of planers. To look at it from a distance you *(Continued on page 119.)*

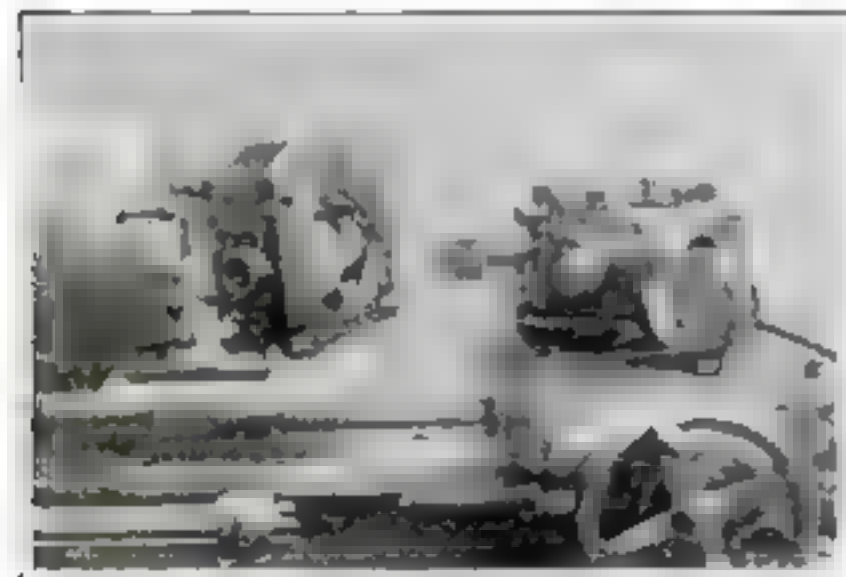


Fig. 2 Indexing chuck on a turret lathe arranged for machining both sides of parts such as valve gates without resetting

"Well, it's doing fine, and we are running it at lower cost than before. Now I could easily figure out what it saves me in tool steel, but that is not the point. We have put a new wheel on it. I want you to see it."

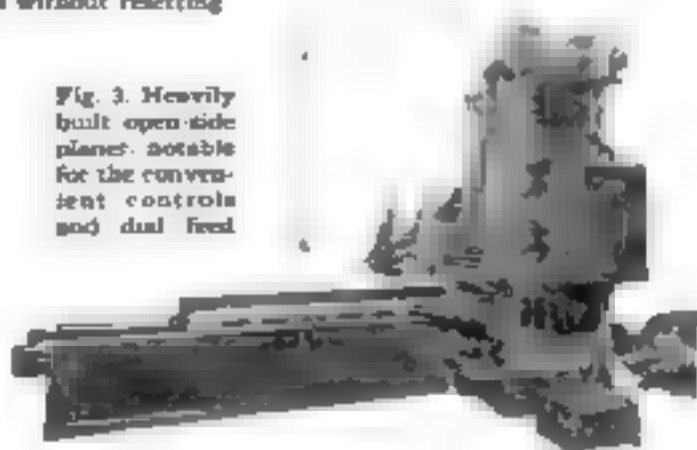
Together they walked into the plant and Bascom led the way to where the surface grinder was merrily at work.

"Now, in place of using a

great big solid wheel we have a cast-iron chuck that holds segments of abrasive material. The abrasive segments cost less than a solid wheel, and we can use them up almost completely, for they can be reset in the chuck several times. Here is one of the chucks off the machine."

They looked at the chuck (Fig. 5, page 120).

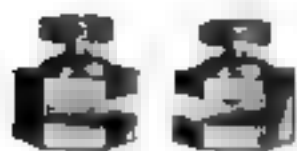
Fig. 3 Heavily built open-side planer, notable for the convenient controls and dual feed



MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, to be found on pages 114 to 122.



"Have you got these new ones?"



No. 470 Steel Square Features

Every man who uses a steel square will want these handy little attachments. They're inexpensive and take up only a small corner of the tool chest but they're mighty convenient to have.

"A man's got to keep up-to-date these days or he'll find himself out of luck. And th' only way t' do it is t' keep his tool kit up-to-date."

"Take these new Starrett's. Every one of 'em a real help to a man who wants to do his work better, quicker and easier. They keep you a jump ahead of the other fellow."

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World's Greatest Toolmakers
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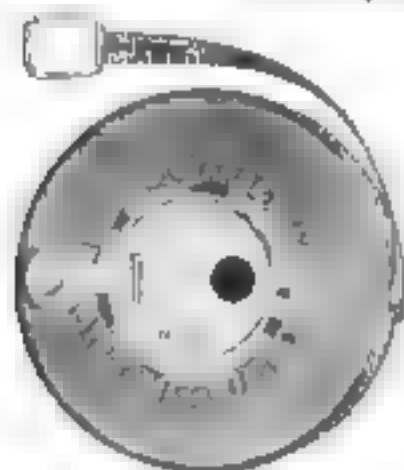
No. 330K Steel Rule with Klip

The Klip will appeal to the thousands of men who always carry a rule in their pocket.



No. 151 Hack Saw Frame

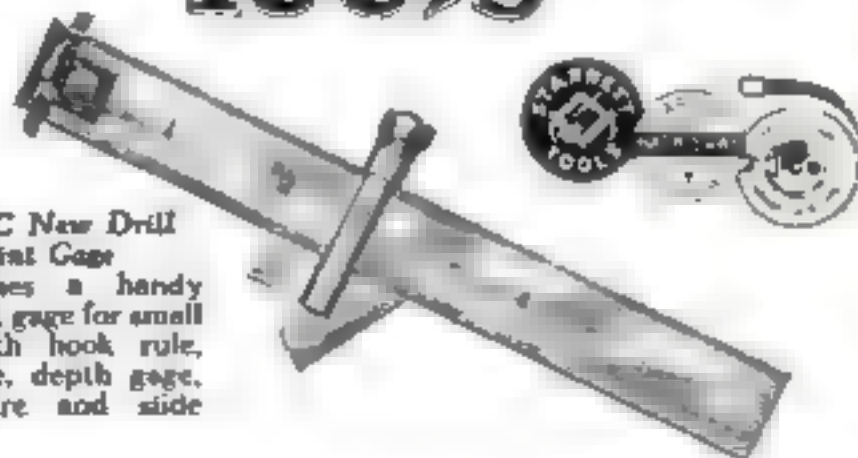
Designed for work in close quarters. Handy around the house and car, too.



No. 520 Stainless Steel Tape

A tape that cannot rust. No need to scour the figures off trying to keep it clean. In 50, 75, and 100 ft. lengths with leather case and push button handle.

No. 22-C New Drill Point Gage
Combines a handy drill point gage for small drills with hook rule, plain rule, depth gage, try square and slide caliper.



No. 66 Thickness Gage

Has twenty six leaves making a complete set from .0015 to .025.

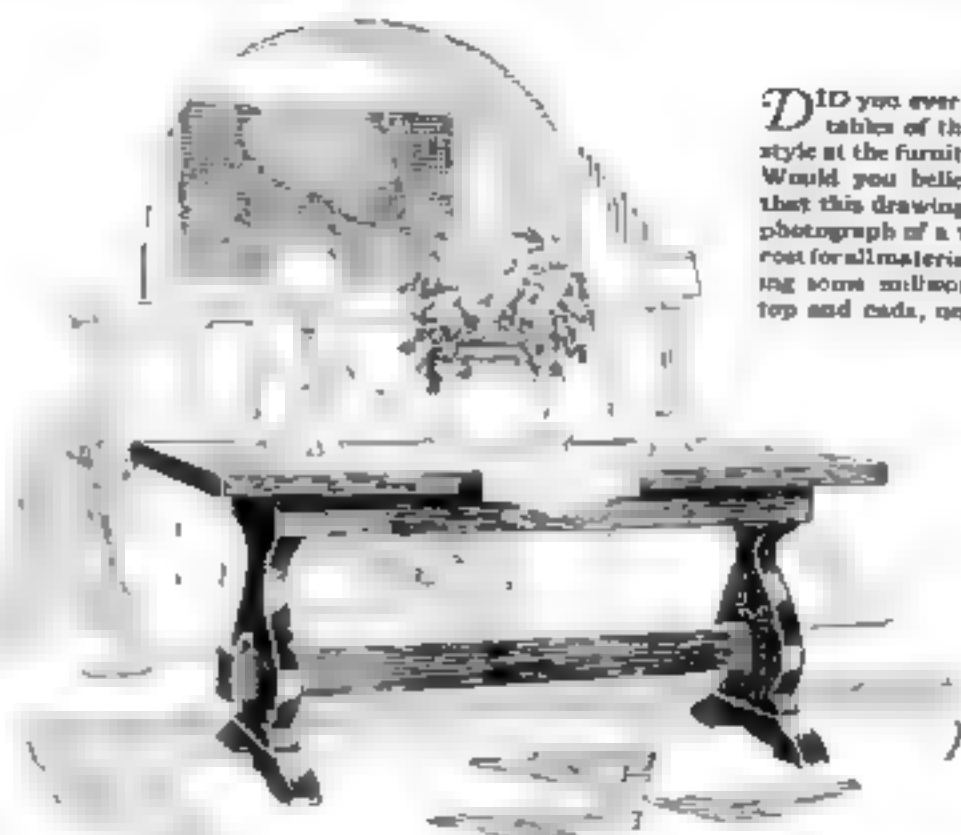


Here's a New One

A real Finishing Hammer—and it's a Cheney.

The extremely slender handle on the Cheney Finishing Hammer—a brand new idea—has a spring which causes quick rebound from the nail. The high crown face on the driving end prevents surface marking. For finishing work you won't find another hammer like the Cheney. It's just the sort of hammer you've always wanted for driving finishing nails. And it pulls 'em just as well as it drives 'em.

Besides, this new Finishing Hammer has all the other Cheney Hammer features, from the tool steel head and the hickory handle with its "Never Slip" grip, to the famous Cheney "hang" that you never can find in any other hammer. It's a new one—and a good one.



DID you ever price fine tables of this general style at the furniture store? Would you believe, then, that this drawing is from a photograph of a table that cost for all materials, including some millwork on the top and ends, only \$9.20?

Even the Beginner Can Build This MASSIVE LIBRARY TABLE

By HERBERT C. MCKAY

NO MATTER how little experience you may have had in woodworking, you can undertake the construction of the table illustrated with every assurance of success. When completed it will compare favorably in appearance with expensive pieces sold in furniture stores.

One of these tables, made entirely of cypress, cost \$9.20 for all materials, and that included the hand sawing of the end pieces and the gluing up of the top at the mill. For those who own tools for joining the top and sawing the ends, the cost might be kept within \$4 or \$5; prices, however, depend a good deal upon local conditions. Other woods, such as chestnut, whitewood or oak, may be used.

The top is made of two pieces, each 1 1/4 in. thick, 1 ft. wide and 3 ft. long. The joint is tongued and grooved, then glued.

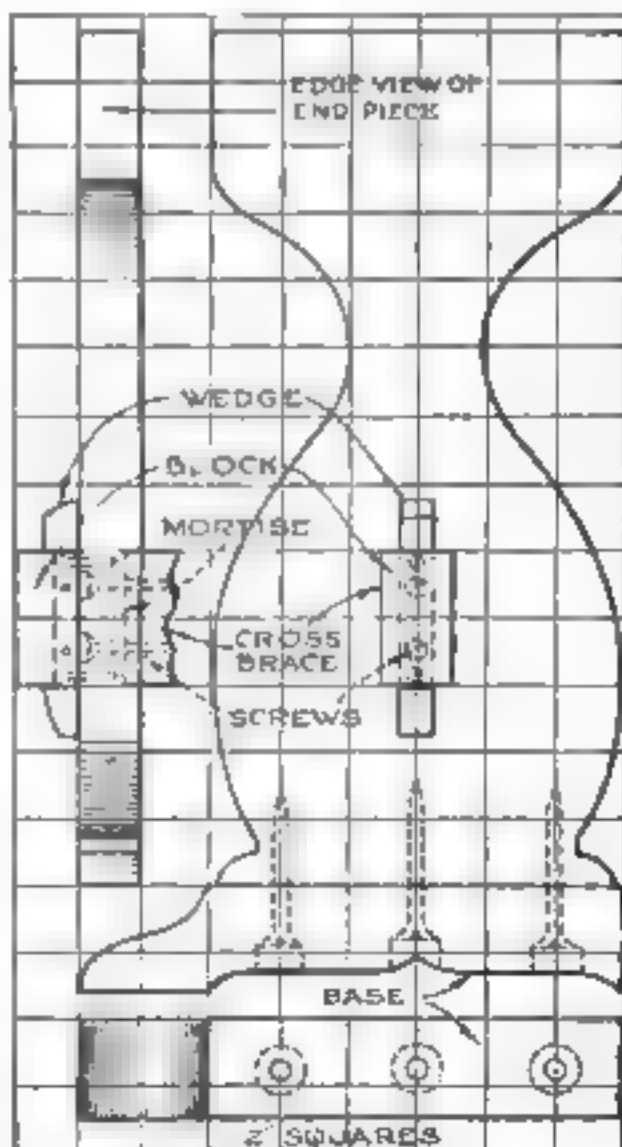
The ends are sawed from 2-in. stock. The 4 1/2-in. straight section at the top of the ends is to take the aprons or side rails. By this method of construction there are but two apron pieces needed instead of four.

The base pieces are sawed from 3 by 3 in. stock. The cross brace is a cypress two by four 3 ft. 11 in. long; the aprons are 1 by 4 by 4 ft. 2 in.

THE first step is to smooth all the pieces. The scrolled ends will have fairly deep saw marks along the edges. As a rasp on this soft wood will leave marks almost as bad as the saw, the first smoothing cut is made with a half-round bastard file. This removes the ridges, but leaves the deeper saw marks.

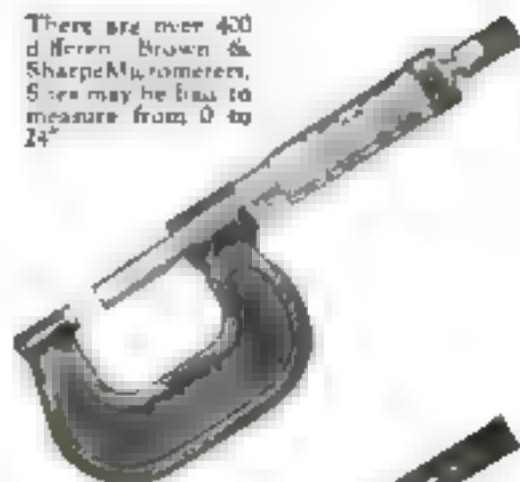
Divide a sheet of heavy window glass into pieces about 2 by 6 in. Hold one

almost flat against the wood and pull it toward you. A thin shaving will be cut from the wood and in a short time the saw marks will be gone. Now hold the glass upright and use it. (Continued on page 80.)



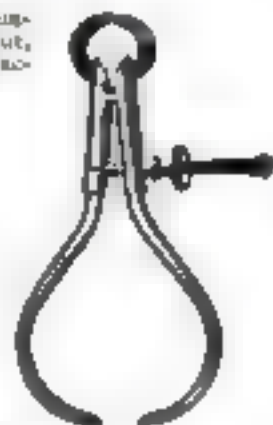
Make a full size paper pattern of the ends and feet to guide in sawing them to shape.

There are over 400 different Brown & Sharpe Micrometers. Sizes may be had to measure from 0 to 24"

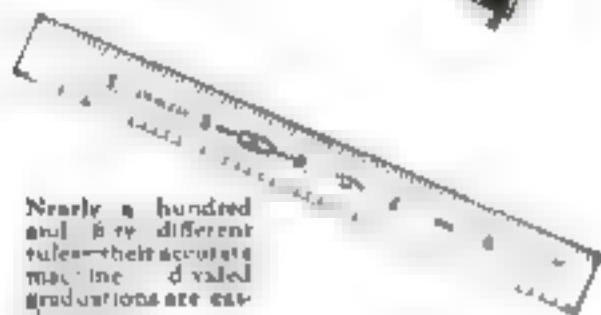


Vernier graduations, machine cut, are uniformly accurate for fine measurements.

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The world of mechanics, toolmakers, students, motor service and repairmen—the man of skill and training—invariably looks for the Brown & Sharpe trade-mark when selecting precision tools.

This trade-mark is symbolic of the highest standard of accuracy to the world of which we speak—a world accustomed to dealing in thousandths of an inch and often in one ten-thousandths of an inch.

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A new light will dawn on your shaving problem when you stop a NEW blade

Most men think that a new blade right out of the wrapper will give the finest safety razor shave possible. It doesn't.

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Here's what Mr. Megrund says:

"When I used the Twinplex stropped blade you sent me, I at once noticed it had a keener edge than any new blade I had used and decided to get a Twinplex although I was skeptical as to whether I, myself, could put such an edge on a blade. But now that I have tried it and find that I can strop my own blades and really improve a new one, I'll say I would not sell it for any price if I could not get another, as it is the best aid to smooth shaving I ever had."

(Signed)

H. C. Megrund, Shelby, Minn.
Why not send for a blade as Mr. Megrund did and see for yourself?

Stropped NEW Blade Free

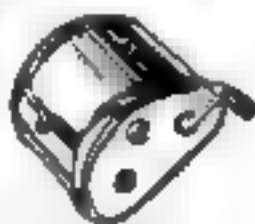
Name your razor and we'll send you, free, a NEW blade stropped on a Twinplex. We would like to show you what real shaving is.

All dealers are authorized to sell you a Twinplex on 30 days trial. If after four weeks of marvelous shaving you are willing to forego the comfort and economy you have enjoyed, give up your Twinplex and get back your money. If you can't find the model you want, write us.

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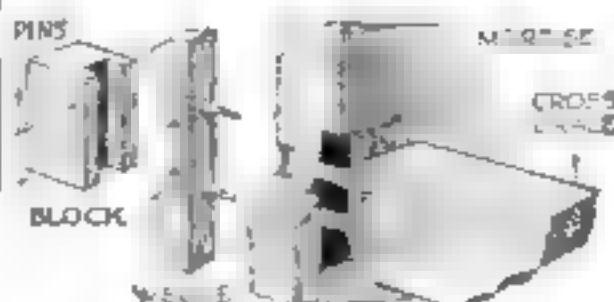
Twinplex

Stroppers



How to Build a Massive Library Table

(Continued from page 76)



The ingenious method of fastening cross braces to ends and concealing the screws

as a wood scraper. This will smooth the surface still more and leave the wood ready for sanding with No. 1 sandpaper.

In sanding, wrap the paper about a piece of broomstick so that you can work into the interior curves. For the exterior curves, use a piece of wood about 1 by 2 by 6 in. as a sandpaper block. After sanding with medium paper, go over the work again with fine sandpaper (No. 3/4 or 0).

Mortises are cut in the end pieces 1/4 in. deep to receive the cross brace. The lower edge of the brace is 6 in. from the bottom of the end piece, or 9 in. from the floor line. When the mortises have been chiseled out, scrape and sand the sides of the end pieces.

The feet have three 1/4-in. holes drilled through them and are counterdrilled 1/2 in. in diameter and 1 in. deep. These holes take the screws which hold the ends to the feet.

The apron pieces have two 1/4 in. holes drilled in the ends and are counterdrilled 1/4 in. in diameter for a depth of 1/2 in.

The feet are fastened to the ends with heavy wood screws (3 in. or longer). The cross brace then is set in the mortises and secured in the same manner. Do not set these end screws too firmly at this time.

Holes 1/2 in. in diameter and about 3 in. deep are drilled in the edges of the aprons about 2 ft. apart. They are then drilled through with a 1/2 in. drill.

The top is laid face down and the entire assembly turned upside down. It is then placed in proper position. Three diagonal

end block, which fits over it, will coincide exactly with the position of the true cross brace, as shown at the left. The blocks are intended to appear exactly as the cross brace would if it actually passed through the ends.

Holes 1/4 in. in diameter are drilled in the brace end blocks as shown and corresponding holes are drilled in the wedges. The block is slipped over the wedge and lengths of 26-in. wire are inserted in the holes.

The table is set up and the top carefully scraped and sanded. The finish may be either wax or varnish; in the table described, a walnut stain and wax finish were used.

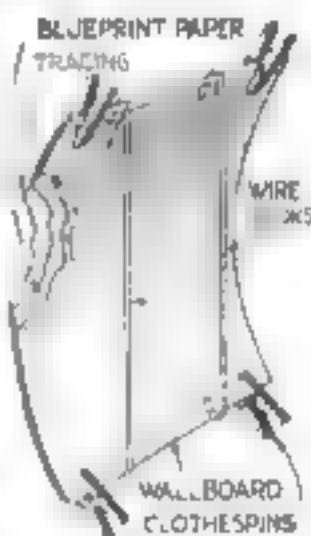
For the coloring, use a good spirit or oil stain, not a cheap varnish stain. The stain is applied with a brush and immediately wiped off with a cloth. This serves to bring out the beauty of the grain. Allow the stain to dry thoroughly. Then apply a thin coating of best white shellac and allow it to set overnight.

The table then is ready for waxing with paste or liquid wax applied with a rag and polished with a soft cloth. Do not wax the entire table before polishing; wax a portion and polish, then proceed to another portion. Two coats of wax thoroughly polished will give a beautiful and enduring finish.

Wallboard Used As Substitute for Blueprint Frame

OFTEⁿ the home workman would like to make one or more blueprints of a drawing he has prepared, but is prevented from doing so by the lack of a printing frame. By a simple method, however, he can make his prints without a frame.

A piece of blue wallboard of a size a little larger than the tracing is obtained. First the processed or prepared blueprint paper and then the tracing are placed on this wallboard and held by means of spring clothespins. The board is bent to a slight curve and held with wires as shown. Then the whole is exposed to the light in the usual manner.—W. J. EDMONDS, JR.



How to make a blueprint in an emergency

Bill of Materials

No. Pos.	T	W	L	Part
1	1	2	6	1
2	1	12	2	Ends
2	1	3	30	Aprons
2	1	4	40	Aprons
1	1	4	40	End Blocks
2	1	1	1	Wedges

All dimensions are in inches.

1/4-in. holes are drilled through the top edges of the end pieces and counterdrilled for 2 in. screws, which are inserted into the top. The screws holding the cross brace in position then are set firmly. The aprons are laid in position and screwed to the top and to the end pieces by means of 2-in. screws. The 1/2-in. holes then are plugged.

The "wedges" are next prepared. These serve as a finish and cover the screw holes in the end pieces. Each wedge is sawed from a piece of 1 by 1 by 6 in. stock and is screwed in such position that the

Drying Shoes Electrically

WHEN shoes, rubber boots or overshoes are damp inside, they may be dried thoroughly in half an hour, I have found, by means of a lighted electric bulb on an extension cord. The heat is so mild that the lamp may be inserted directly in the shoe or boot.—H. J. VALLENER.

Enjoy the Satisfaction and pride of owning these Guaranteed Unbreakable tools, they **GIVE YOU** the highest standing in your trade by using them

Mr. Robert Currie, Rahway, N. J., says:

I am very pleased with your hammer and am getting a hatchet. I find the hammer perfectly balanced and it is the first one that does not give me wrist ache after a hard day at sheeting.

G. Anderson, Minneapolis, Minn., says:

Yours is the most remarkable hammer I know of, a perfect wonder, just what I have been waiting for, for 40 years, enclosed find money for another.

Ernest Gustavson, Kane, Pa., says:

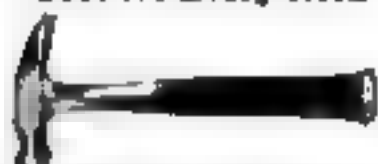
Enclosed find check for \$6.45 for which please send me 2 12-oz. and 1 16-oz. Hammers. I would like to see a dealer here, as I know they sell. This makes 19 I have bought.

This is the Reason Why Many DEALERS

have ordered 8 times in a few months and one

WHOLESALE ordered 23 freight shipments between March 12 and Dec. 7, 1926.

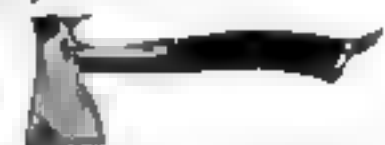
An Estwing Unbreakable Tool for Every Need



Best for Electricians, Gas Fitters, etc. Grip is a non-conductor of electricity, heat or cold.



Scout Ax, sporty appeal and absolute dependability. Thin easy cutting bit. Unsurpassed for hunters.



Util-Ax has many practical uses, the strong tempered claw at end of handle will get any nail anywhere, prying, straightening clenched nails etc. The hook pulls staples, opens boxes etc. Thin easy cutting bit. Indispensable for touring, farm, home, camp, store.



Thin bit, easy cutting, easy grinding.



FORGED in ONE PIECE of fine tool steel, grip of sole leather washers, pressed and riveted on to the I beam core, polished and lacquered.

Superior in **EVERY WAY**. Every tool carries a tag guaranteeing by free replacement that the light tempered steel handle and comfortable grip

ESTWING UNBREAKABLE

CAN'T BREAK or LOOSEN

no matter how or how long used

are the new era **PATENTED** tools being rapidly adopted by the Carpenters. Used by large industries where all others failed. Approved by university and wholesalers laboratories.

Selling fast by the hardware trade because:

1. The handle can never break, loosen or splinter,
2. Easier and surer drive.
3. Finest grip and feel.
4. Unsurpassed temper.
5. Weather proofed.
6. Appearance as superior as the quality.
7. Saves cost many times over in easier work, freedom from delays, trouble and expense.

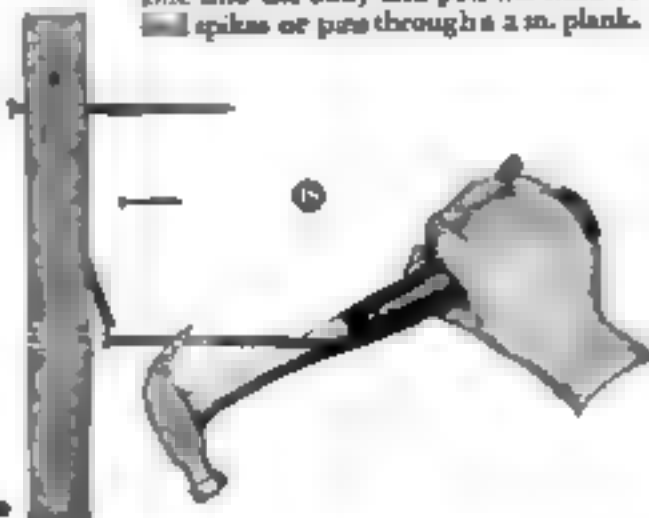
We made them for **YOU** if **YOU** want the **BEST**. Wanting or wasting, we guarantee satisfaction or refund your money in 30 days if you wish.

Show this to your dealer, he will be pleased to serve you. Or send money with order, enclose 15c extra for each tool ordered which pays postage; or pay mail man.

<input type="checkbox"/>	Curved Claw Hammer, 12 oz. Head	\$2.00
<input type="checkbox"/>	" " " 16 " "	2.00
<input type="checkbox"/>	" " " 20 " "	2.25
<input type="checkbox"/>	Straight " " 12 " "	1.00
<input type="checkbox"/>	" " " 16 " "	2.00
<input type="checkbox"/>	" " " 20 " "	2.25
<input type="checkbox"/>	Half Hatchet No. 2, Smooth Face	2.25
<input type="checkbox"/>	Half Hatchet No. 2, Scored Face	2.25
<input type="checkbox"/>	Util-ax, 20 oz. with Leather Sheath	2.25
<input type="checkbox"/>	Scout Ax, 24 oz. with Leather Sheath	2.00

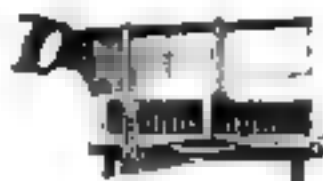
Prove this Yourself

Bite into the body and pull the head of spikes or pins through a 2 in. plank.



ESTWING MFG. CO., Rockford, Ill.

GOODELL-PRATT



All Speed Motor Saw—1188. Cannot bend or break, or become inaccurate. Angles more acute than 45° are secured by side attachment. Gauge can be regulated to saw to any desired depth. Equipped with 36 x 5" best quality Back Saw. \$27.50.



Bench Vice—2010. 18" opening. Steel cast head on roller bearings. Hand and handle finished with rubber enamel, shock effect. Check sockets and plates of malleable iron. Largest steel plate. Checks hold all sizes of square shank bits. Beautifully finished. \$5.75.



Automatic Drill—109. Mc. Punch. Push, and the tool returns. Drill points cut to handle. Length 18". Brackets fully polished and nickel-plated including 8 drill points from 1/16 to 1/4". \$2.75.

Two Speed Hand Drill—58. Work enamel frame. Hand-Dr. unknown in hold drills. Takes round shank drills, 8 to 1/4". Steel parts nickel-plated. 7/8" long. Without drill. \$5.50.

Automatic Sprocket—131. Revolving, for driving or drawing screws. Can be used ratchet or plain. Handle finished in mahogany. Length with blade 18". Including 2 steel gears. \$3.50.



GOODELL-PRATT



Goodell-Pratt Electric Drill. Runs from 1 to 5-1/2". Light and Heavy Duty for 110 and 220 A. C. or D. C. Heavy drilling doesn't overheat these Drills. Self-oiling bearings require only occasional attention. Vial parts readily accessible. These drills retail from \$24.00 to \$49.00.



Micrometer Caliper—2-8. Designed to read by 1/1000 from 0 to 1 inch. Ratchet mechanism on the Thimble assures equal pressure, when used by different persons. \$12.00.

Bench Vise—143. Moderately priced. Cut steel head screw and guide rods more rigidly. Jaws machined after assembly so they more accurately hold parts polished, even parts expanded. 7/8" jaws, opening 3". Weight 2 3/4 lbs. \$12.00.



High speed, high power Bench Grinder—444. Handy for bench and household use. Gears are enclosed and packed in grease. High Aluminum Wheel, 5 x 1". Adjustable Work Rest. Finished in red and black enamel. 6 1/2" high above bench. \$16.00.



Spring Drill—4. 14" long. Adjustable Brass Fly. Polished Hardwood Handle. Mechanism One Inch Two speeds. All-steel Chuck for round shanks 4 to 3/4". \$6.00.



THE ten tools pictured here are merely single examples taken from the range of sizes in which each is made. Goodell-Pratt Bench Vises come in many sizes. So do Goodell-Pratt Drills, Grinders, Sprockets, etc.

This Book brings your hardware store to your home

HOW often have you skimmed through your dealer's stock of fine tools and wished you had all day to linger over it?

You'll get something of that same thrill—and even more actual information—from the Goodell-Pratt catalog.

Over 1500 Good Tools—pictured and described

You can go over them at your work-bench or in your easy-chair. You can take the catalog to your dealer and, instead of vague efforts to make him understand what you want, you can show him exactly what it looks like.

This book brings you the complete line. If

you want a vise, it helps you pick the right size—tells you how wide the jaws open—what thickness bench you can clamp it to. If it's a drill, you'll know its capacity and what points come with it. A three-page index quickly locates the tools you want to find.

With this book it is easier for you to buy—easier for your dealer to sell. It's free, of course. Write us for your copy today. Buy Goodell-Pratt tools from your hardware dealer—or write us for the name of a nearby dealer who sells them.

No finer tools are made than those that carry the name of Goodell-Pratt.

GOODELL-PRATT COMPANY, GREENFIELD, MASS., U. S. A.

MAKERS OF *Toolsmiths* MR. PUNCH

GOODELL-PRATT

1500 GOOD TOOLS

Will Anyone Accept This Pipe-Smoker's Challenge?

Twenty-one years is a long time to stick to any one product—particularly tobacco. Because even though over a period of years a tobacco may not change in flavor or quality, a smoker's taste generally does.

So it is all the more remarkable to receive such letters as that from Mr. Roberts of South Dakota, reproduced below

Columbia, S. D.
Sept. 9, 1926.

Larus & Bro. Co.
Richmond, Va.
Gentlemen:

I am a veteran of the Edgeworth army, still in active service.

I make this claim, challenging all comers, to have smoked Edgeworth and nothing else but Edgeworth when it was possible to get it, for a longer period than any other person within the scope of your territory.

I have smoked Edgeworth for twenty-one years and will soon start on the twenty-second.

I admit to having tried other brands, including so-called high-class, high-priced brands and mixtures, enough to appreciate and realize myself of the superiority of Edgeworth.

In all these years I have never had one can of Edgeworth that varied in flavor or otherwise.

Yours very truly,
(signed) J. J. Roberts.



To those who have not tried Edgeworth, we make this offer:

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality.

Write your name and address to Larus & Brother Company, 10-12 S. 21st Street, Richmond, Va.

We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidor holders a pound, and also in several handy in-between sizes.

To Retail Tobacco Merchants: If your dealer cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

On your radio—tune in WHPA, Richmond, Va., 12.5 mch. section. Wave length 235 meters.

"Old Ironsides" in Miniature

(Continued from page 39)

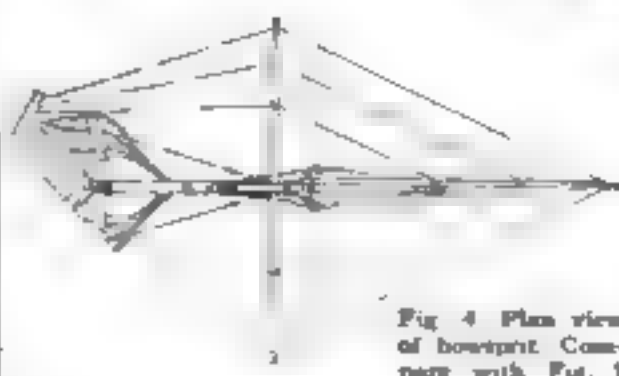


Fig. 4 Plan view of bowsprit. Comparison with Fig. 1.

Have them spaced as evenly as possible.

Now take a topmast, thread the lower cap on it, press the heel into the square hole on the fore side of the lowermast in the top (Fig. 5), and the square hole in the cap on to the lowermast head. Put the crossrees (Fig. 7) into position over the masthead and set up temporary stays.

The topmast shrouds set up to dead-eyes of the smaller size, set into the edges of the tops; there should be five at the

fore and main and four at the mizzen, but I put only four to each.

For these twist a thin wire around two deadeyes with 4 in. between, double the wire in the middle, push one part into each of the thin slots in the edge of the top (Fig. 5), so that when dragged down the deadeyes will lie neatly on the tops. Push the bights of the wires through the lower shrouds and seize a length of the thick cord in them, then set them up tightly to deadeyes fastened to the staples in the deck, on the opposite side of the masts.

Now pass a piece of cord about half the thickness of that previously described through the crossrees, around the topmast head and down again, seize deadeyes in the ends to lie about 2 1/2 in. above the lower ones, reeve lanyards and draw them tight, seize a sheer pole to each set and hitch on the ratlines.

A few spring clothespins, with the bevels sawed off the points, will be found useful for hanging off lanyards and other cords until ready. (Continued on page 90.)

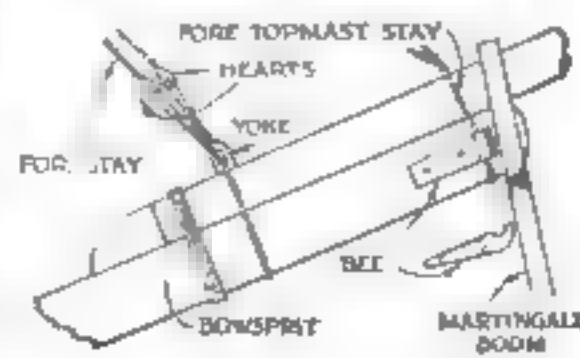
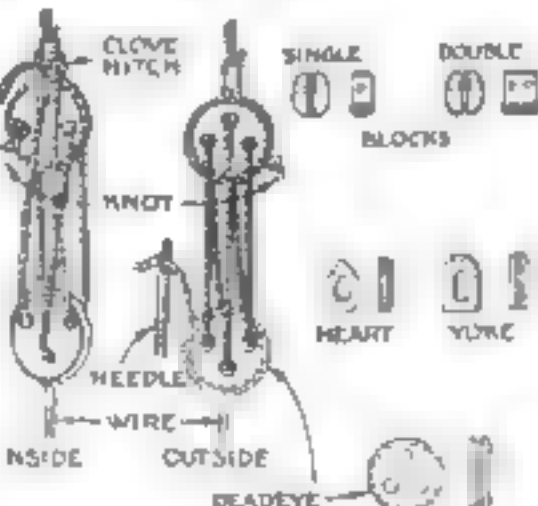
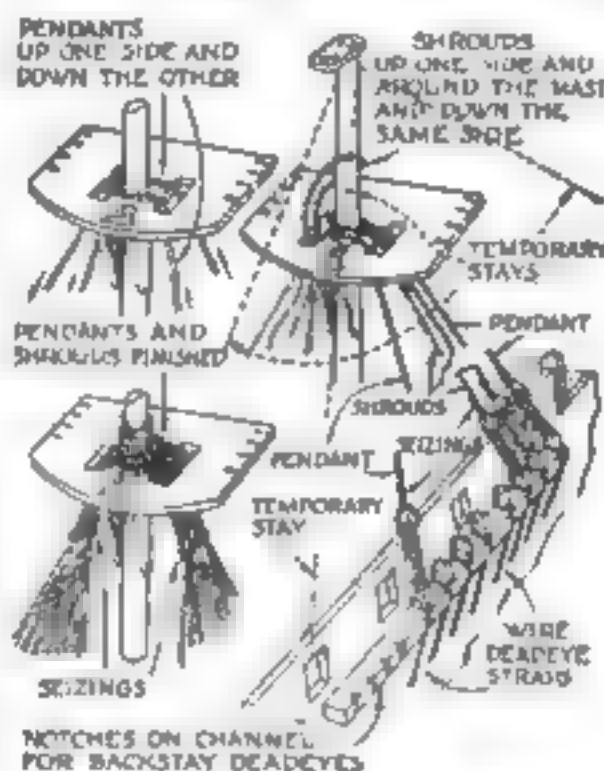


Fig. 3. How to set up shrouds, make dead-eyes and blocks, and attach stays at bowsprit.

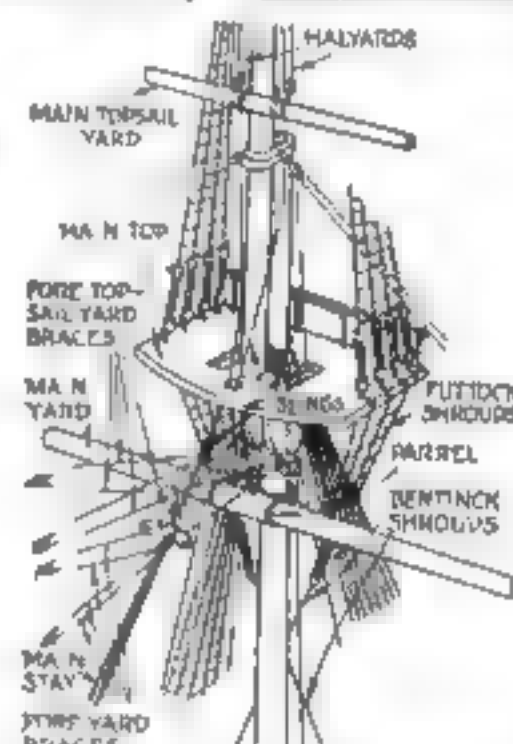
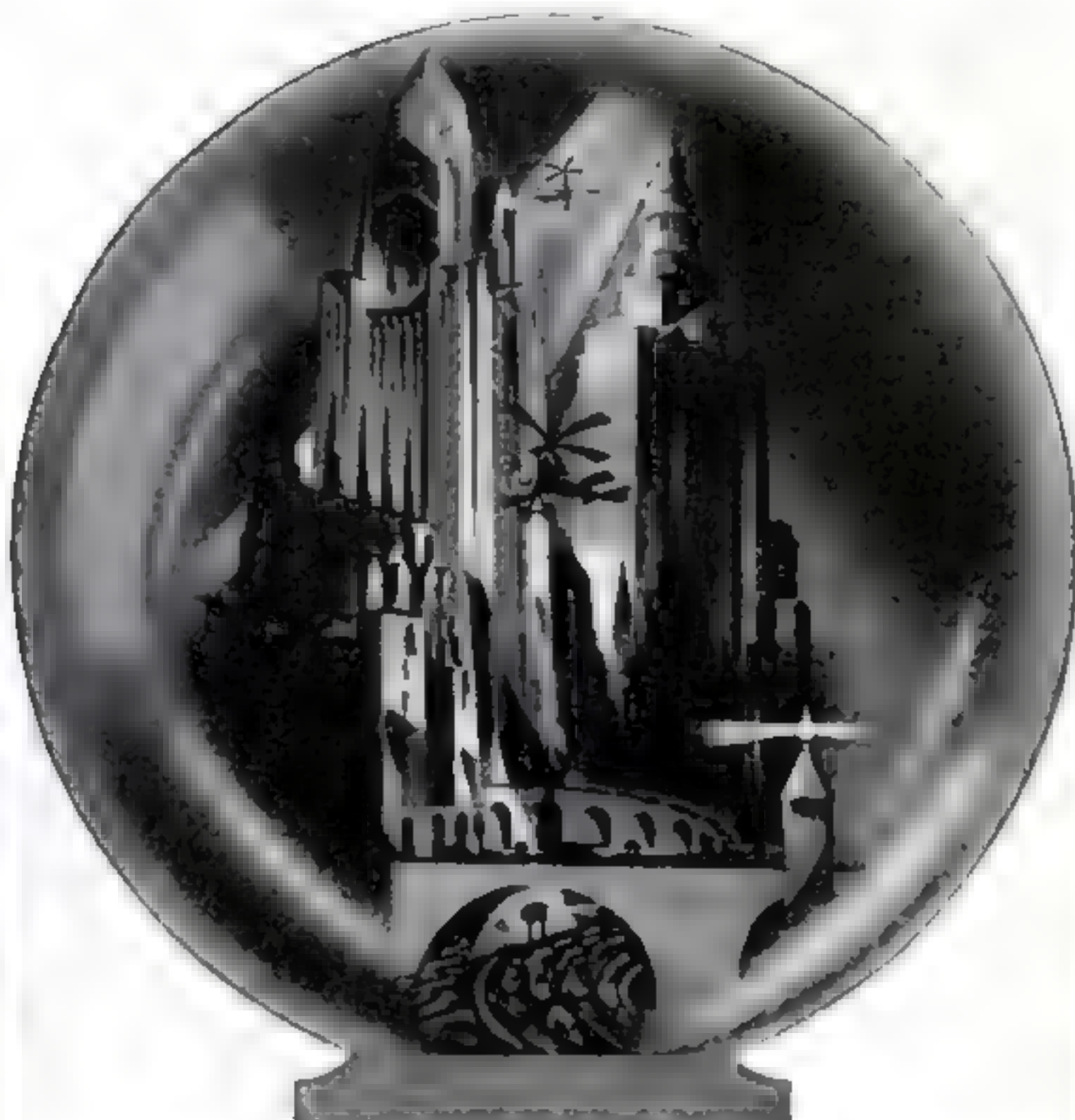


Fig. 5. Mainmast, main yard and main top-sail yard. Fore and mizzenmast are similar.



Looking into the crystal suggests many changes in our big cities during the next 100 years. Perhaps there will be streets on three levels, towers topped only by taxi planes and aerial traffic lights.

But whatever filing needs new changes develop, there will be files bearing Nicholson File Company trade marks made to meet them.

In the future as well as the past, Nicholson File Company trade marks will stand for sharp, durable teeth, correct balance and rigid testing after every manufacturing process.

Look for the NICHOLSON trade mark when buying your files today. It guarantees you the best file workmanship the world has ever seen.



"A File for Every Purpose" [®]

NICHOLSON FILE COMPANY, PROVIDENCE, R. I.



Locate Your Factory At The Center—St. Louis

—For Greater Profits

YOUR factory in St. Louis would be at the nation's center. You would be closer to your customers and nearer your raw material supply. This central location would eliminate the wasteful gap between raw materials and customers.

Manufacturers in St. Louis have solved the costly long-haul problem. They *Ship From the Center—Not the Rim*. In St. Louis you could ship in every direction—by short hauls—to the nation's markets.

St. Louis has more than 3,500 factories in 211 different lines of business. This diversity has given it a national reputation as the "best balanced" large city.

A fair and just Workmen's Compensation Law, enacted at a recent election, is also an additional incentive to consider St. Louis.

We will send, on request, our new booklet, "Why St. Louis Grows"

Address Dept. 16
Chamber of Commerce
ST LOUIS



A Gouge-Made Pen Tray

With an inexpensive block of hard wood, you can easily make a neat desk ornament

By EMANUEL E. ERICSON, *Wood Manual Training Authority*

Gouges serve many purposes and are essential for carving



1 To make a pen tray and ink bottle holder, square a piece of wood, 3 by 11 in., lay out a semicircle $\frac{1}{2}$ in. from one end and another 8 in. away, and connect them with parallel lines

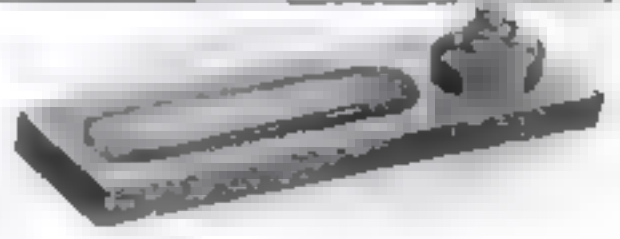
2 Center view above. Place the piece in a vise and hold the gouge as shown, with the left-hand fingers resting on the wood to aid in controlling the tool. Take long, shallow shavings to the middle, then work from the other end



3 When cutting to a curve, make a sweep ng side stroke and move the handle with a circular motion. Cut right to the line, but be careful not to let the gouge slip over it



4 (Left) To aid in gouging out the tray uniformly, while a templet from a thin piece of wood, after drawing an arc of suitable radius with the compass



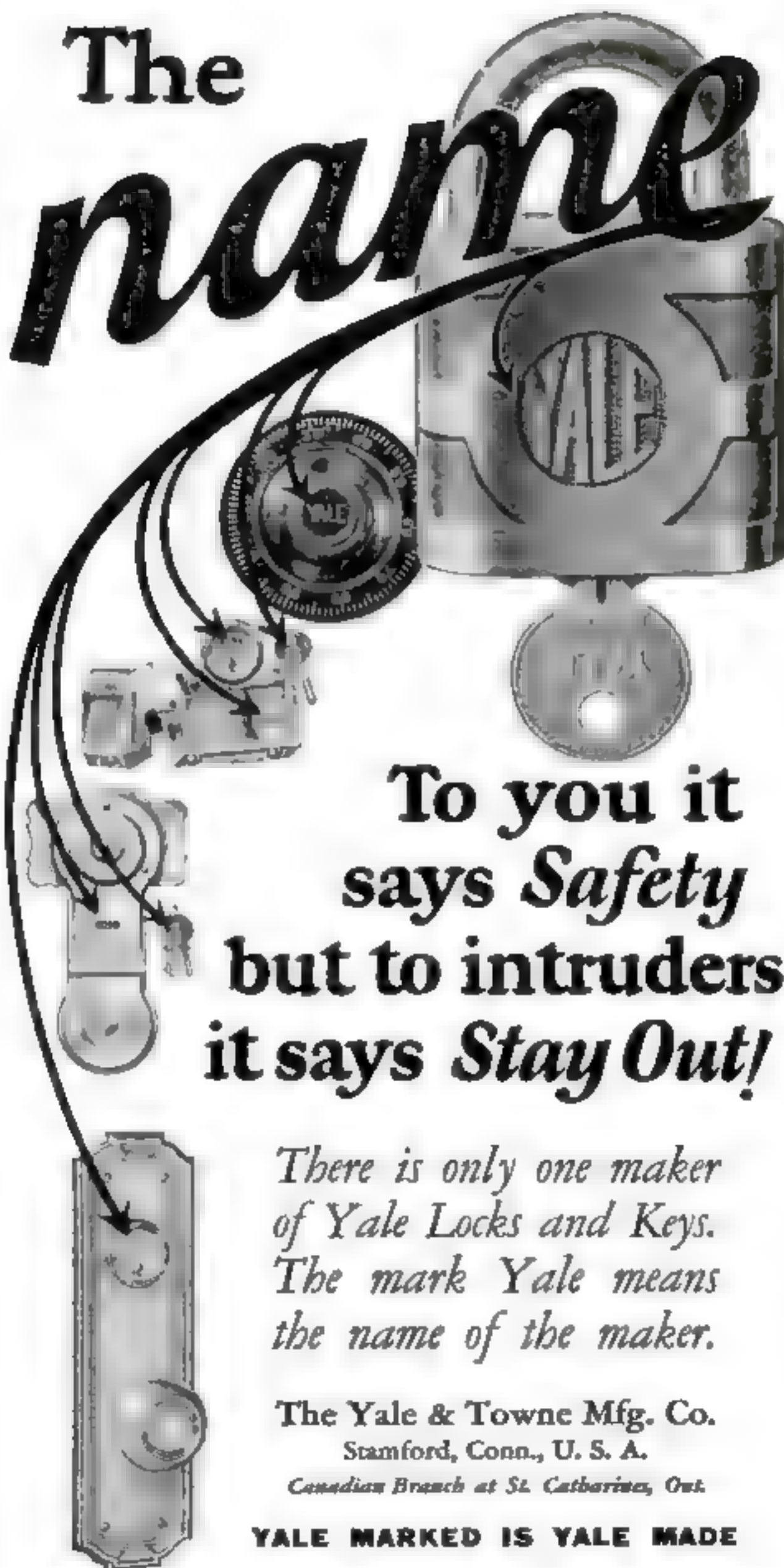
5 The templet is moved from place to place to determine whether the tray is the proper depth and shape throughout. Light showing beneath will register discrepancies

6 (In rectangle above) The depression then is smoothed carefully with sandpaper held in the fingers. Don't round the sharp edges and, if necessary, plane off a shaving to increase their sharpness

7 The finished tray is shown in the last illustration. A round or square hole is made at the end previously left untouched; this hole may receive an ink bottle or form a receptacle for paper clips and pins. The outside edges of the block, but not those of the tray depression, are rounded slightly. The piece then is varnished or shellacked

TRADE **YALE** MARK

The
name



To you it
says *Safety*
but to intruders
it says *Stay Out!*

*There is only one maker
of Yale Locks and Keys.
The mark Yale means
the name of the maker.*

The Yale & Towne Mfg. Co.
Stamford, Conn., U. S. A.
Canadian Branch at St. Catharines, Ont.

YALE MARKED IS YALE MADE



Pocket Ben

For men who
like to be on time

POCKET BEN was raised with Big Ben, Baby Ben and all his other Westclox brothers. They set him a good example and he lives up to it.

You can rely on him for sturdiness and truthfulness, traits that are traditional with the Westclox family.

You'll find Pocket Ben at the stores in your locality. Price \$1.50, with luminous dial \$2.25.

**WESTERN CLOCK
COMPANY**
La Salle, Illinois

A Welsh Dresser Easy to Build

(Continued from page 69)

reproduced at the bottom of page 69 is shown the general construction, but you will find it a great additional aid to obtain our Blueprint No. 60 (see page 105). This has the assembly drawings on a much larger scale than can be given in the magazine, as well as some full size details and a complete bill of materials or cutting list.

The cabinet is made throughout of white pine, which can be obtained from any lumber dealer. The panels for the doors and ends are plywood, although they can be made of solid stock. If the piece is to be given a natural finish, they are best if faced with pine to match the rest of the wood, although maple, basswood or whitewood might be used. Plywood panels also are needed for the back of the lower section of the case and for the cupboard bottoms; these may be faced with any inexpensive wood.

THE back of the upper section of the case is made of $\frac{3}{4}$ by 8 in. tongue-and-groove white pine "ceiling." Most of the other parts are cut from $\frac{3}{4}$ in. thick boards, you will find the exact sizes of each given on our Blueprint No. 60.

Other woods, such as maple or oak, can be used and, indeed, the builder has considerable leeway in working out his own ideas in connection with any project of this type.

The tools required are rip saw, panel (fine crosscut) saw, jack plane, block plane, screw driver, $\frac{1}{2}$ -in. chisel, hammer, nail set with $\frac{1}{8}$ in. point, miter box, try square, bit brace, $\frac{1}{4}$ -, $\frac{3}{8}$ - and $\frac{1}{2}$ -in. auger bits, countersink, $\frac{1}{4}$ - and $\frac{3}{8}$ -in. twist drills for wood, rule, 8-in. half-round cabinetmaker's file, 14-in. turning saw frame with $\frac{1}{4}$ in. wide saw blade, $\frac{1}{4}$ in. grooving plane, and rabbit plane. The last named planes and the turning saw may be omitted if what little grooving and rabbeting is necessary and the sawing of the ornamental curves is done at a woodworking mill. Additional tools as well as hand screws and long clamps, can, of course, be used to advantage, but those mentioned will suffice.

Cut all the pieces to the dimensions given in the bill of materials on Blueprint No. 60, or from your own list prepared with the aid of the drawings. All the pieces are marked with identifying letters on Blueprint No. 60 and, as far as possible, on the illustration on page 69.

A good beginning in the work is to dress the stiles and rails of the lower case straight and square. The time spent in doing this will be more than saved.

Assemble the end stiles W and X and the end rails Y and AA of both ends. Fasten together with liquid glue and nails or long slender screws; the latter will in-

sure your having a stronger case. Be sure the surfaces are flush and that each joint is as strong as it can be made. Plane and sandpaper the surfaces of the ends, miter the molding II around the panel openings, put panels III in place and fasten strongly with $\frac{1}{4}$ in. quarter-round molding on the inside.

Make the center and bottom frames, using stiles VV, and drawer runners and closet ledges UU. Set up the case by nailing through the ends into the ends of the center and bottom frames, being sure they are placed accurately in relation with each other and the top and bottom of the ends of the lower case. The frames should be placed so that they project $\frac{1}{8}$ in. be-



Photo courtesy Kensington Museum/Artists' Company

An early American pine dresser in a recent industrial art exhibition at the Metropolitan Art Museum, New York

yond the front of end stiles W.

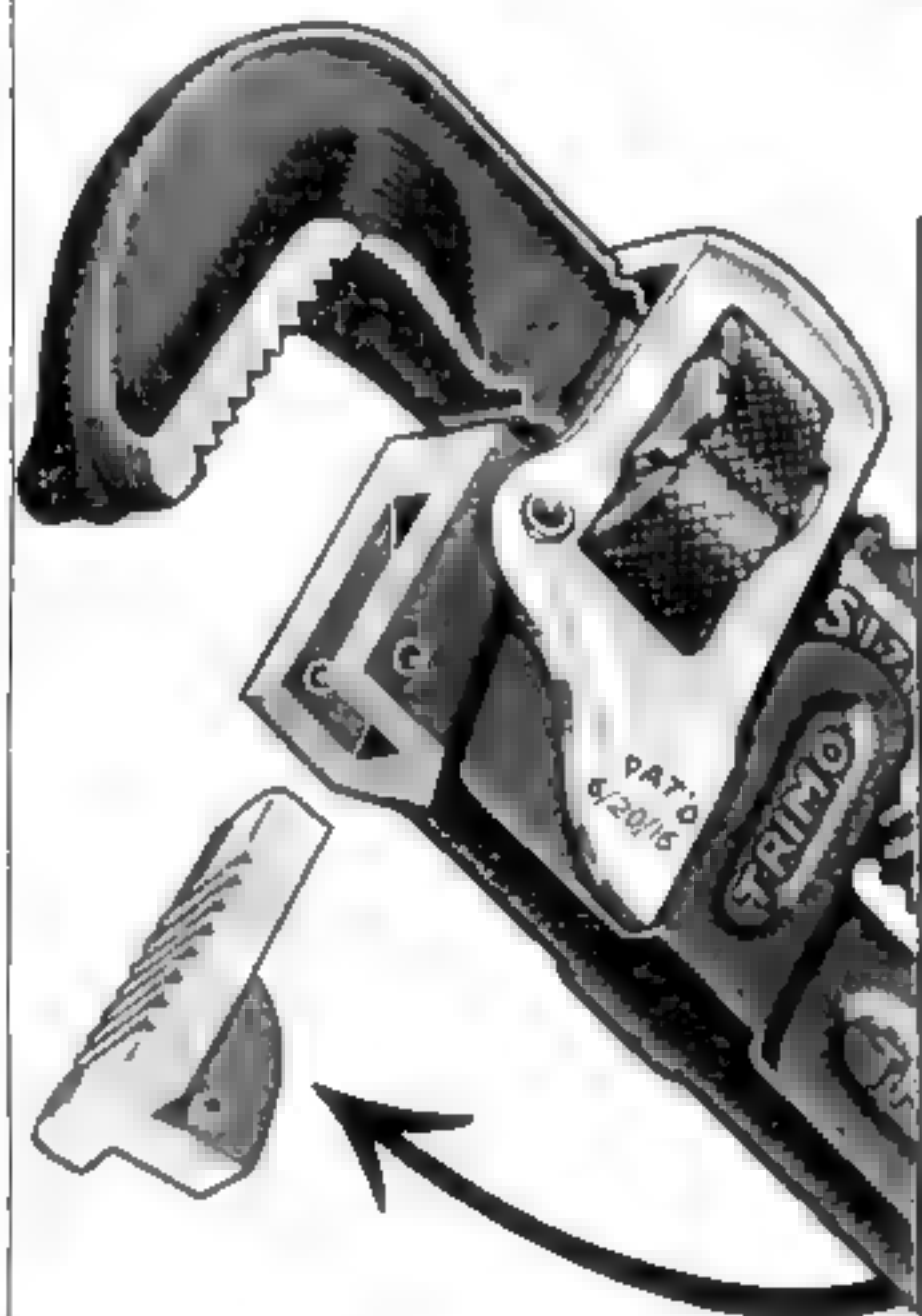
Square the case accurately and hold it with temporary braces. Place the braces so they will not interfere with putting the back in place. Then fit the front stiles V; this will involve notching the frame stiles VV to receive them.

FASTEN the front center stile GG so as to divide the space for the doors into two equal parts. Assemble the frame under the top after mitring the front corners of the front stile H and the rails S. The back rail is square at the ends and fits between the rails S. A furring strip YY is placed over where one of the closet partitions SS is to be located later.

Fit the back XX, which is preferably $\frac{1}{2}$ in. plywood, and fasten strongly; the permanent rigidity of the entire case depends largely upon the back. Fasten the partition RR, adjusting it by means of the case bottoms QQ. Make partitions SS for the small drop door compartments, with facings TT to hide the end grain. Drive screws or nails through rail VV into SS, adjusting by the drop closet bottoms PP. Be sure that the partitions are parallel to each other, even if the distance apart does not coincide exactly with given dimensions. This will simplify fitting the drawer.

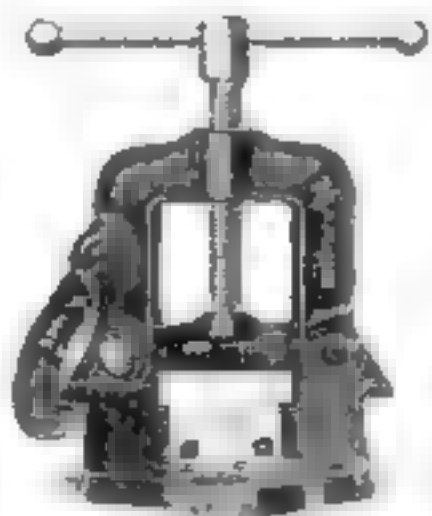
Saw bases BB (Continued on page 90)

TRIMO



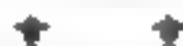
TRIMO PIPE VISE

A HANDY, rugged tool for home, shop, or farm. Has tempered tool-steel jaws with fine-milled teeth which grip firmly. Yoke, frame and base are of guaranteed malleable iron. Screw, head, and handle are of selected steel. Patented device insures smooth hand grip. Made in seven standard sizes. Absolutely guaranteed.

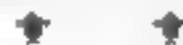


The Pipe Wrench with the Replaceable Insert Jaw and Nut Guards - - -

WHEN large American tool buyers (railroads, oil companies, power plants, plumbers, etc.) have to settle the question of wrench economy, TRIMO almost invariably gets the verdict, even though the first cost of this rugged Pipe Wrench is a few cents more than others. Why is this?



Just consider one point alone—the INSERT JAW in the handle, an exclusive TRIMO feature. After the TRIMO has rendered long and hard service, this jaw can be quickly replaced at small cost. With other makes an entirely new wrench would have to be bought. NUT GUARDS which keep the TRIMO adjusted constitute another economic (time and labor saving) feature. Pressed steel frame is practically unbreakable.

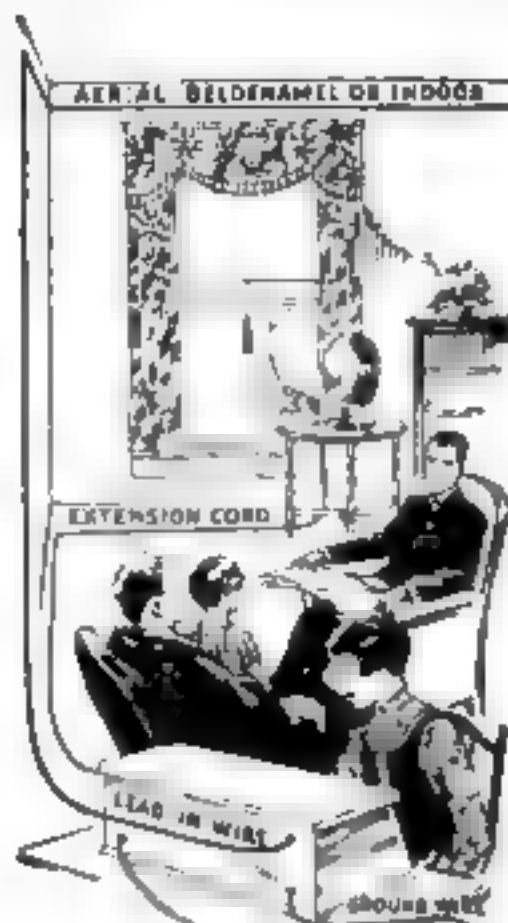


Replaceable parts, maximum strength, masterly design, and many other exclusive points have made TRIMO the preferred Pipe Wrench among large and small users for nearly 40 years. Made in eight steel-handle sizes from 6 to 48 inches; four wood-handle sizes, 6, 8, 10, and 14 inches.



At all hardware, mill, plumbing, and oil-well supply stores. Insist on TRIMO—accept no other.

TRIMONT MFG. CO.
ROXBURY • MASS.



**This Radio Set is
properly Installed**

Is Yours?

FOR an outdoor aerial, use a Beldenwired Aerial. It cannot corrode or deteriorate. For indoor aerials, use the Belden Indoor Aerial Wire. And do not forget Belden Lead-In and Ground Wire to finish the job. All of these items are included, if you wish, in the new Belden Super-radio Antenna Kit.

The Belden 20-foot Loud-speaker Extension Cord brings the loudspeaker where you want it. For safety to tubes and batteries, and protection against fire, use a Belden Fused Battery Cord.

Ask your nearest dealer to explain how Belden Radio Accessories help you get better results from your set.



**Belden
Fused Radio
Battery Cord**

Belden Manufacturing Co.
2304A S. Western Ave., Chicago, Ill.

A Welsh Dresser Easy to Build

(Continued from page 88)

and CC to the shape shown, smooth them, miter at the front corners, and fasten with glue and nails.

Make the doors of stiles DD, rails EE and EF, and panels FF. Miter the molding II, fit the panels and fasten with quarter-round XA, as in the ends.

DROP doors KK and drawer front LL with moldings JJ should be made next. Fit drawer front LL between partition facings TT and assemble drawer sides MM, back NN and bottom OO. Fit the completed drawer and drop doors and hang the latter with $1\frac{1}{4}$ in. wide brass butts. The drawer may be stopped $\frac{1}{4}$ in. back of the face of the case by gluing a piece between the back of the case and the rear of the drawer.

Make holes for drawer pulls in the fronts of the drawer and drop doors. When the case is ready for finishing, these trimmings should be removed, as they will be in the way. Fit and hang lower doors with 2-in. butterfly hinges.

Round the edge of the cabinet top B and fasten with screws, which pass up through R and S.

One or more shelves XB and two supporting cleats XC for each shelf may be made if desired and fitted and fastened at convenient distances from the case bottom. The drop door supports XD will serve to hold the doors in place when they are closed.

Assemble the upper case or rack by nailing the three shelves D between the ends C. Make the top cornice by nailing the under furring or soffit G, the top furrings ZZ, and the back furring F strongly together and mitering and nailing the frieze molding E. Nail strongly through G into the top ends of C. Nail top A in place so as to rely more upon nails into the furrings than in the moldings.

NAIL back H, which is 2-in. tongue-and-groove stock, in place. The nails go into the back of shelves D, soffit G and rabbets previously made in C. Be sure the case is square when the back is nailed. A little glue in each joint of the back will add much to the rigidity.

A piece $\frac{1}{4}$ by $\frac{3}{4}$ by 1 in. long should be fitted and glued to each back corner of G to make G flush with the case back.

Fit and fasten the bead molding along the edges of G and add the ornamental top frieze I. Fit the top case or rack in its place upon the bottom case and bore for dowels to hold it there. Fit the stretcher J to the top surface of B and nail it to the back with small brads driven slantwise.

Make the knife box by assembling pieces J, K, L, M, N, and O. Miter the front corners of this little case. Note that the back N is set forward so that the back ends of L may be notched to fit over the stretcher J.

Set the nails $\frac{1}{4}$ in. below the surface of the wood. Sandpaper the entire case, touching all square corners to remove lightly the slight burr always left by the plane. No. 0 or 00 sandpaper is not too

fine for the last rubbing. Be sure that there are no finger marks, soiled places or other imperfections which can be removed. The case then will be ready for finishing.

It is important that the piece be kept in a warm room during the finishing.

For a natural finish, dust off well and apply an "antiquing" stain made by dissolving 4 tablespoonfuls of air-drying asphaltum varnish in a pint of gasoline. This dresser will require a quart of stain. Four hours should be allowed for the stain to dry.

Apply a coat of orange shellac reduced fifty percent with denatured alcohol and allow it to dry for three hours. Sand smooth with No. 6-0 sandpaper or as fine as can be obtained, working with the grain and "highlighting" by sanding through the color and exposing the pale wood wherever the light strikes the curved edges and produces a shine.

Dust off and coat with orange shellac reduced only one quarter with denatured alcohol. Use a 1-in. sitch brush for the edges and a $2\frac{1}{4}$ -in. brush for all flat work. Allow at least three hours for drying and resand with split No. 6-0 paper.

After dusting off, apply a coat of clear brushing lacquer, using the sitch brushes, which have been washed free of shellac in lacquer thinner. After drying two hours, recoat and allow the second coat to dry overnight.

Rub to a smooth finish with rubbing felt, FF pumice stone powder, and crude oil; then polish with wax or polishing oil.

FOR a painted finish, using, for example, pale ivory and delicate blue brushing lacquer, dust off and give a sizing coat of shellac reduced fifty percent with denatured alcohol. Allow it to dry for three hours. Sand smooth with worn sandpaper of the finest grit. Dust off and brush on a coat of pale ivory lacquer, allowing two hours for drying. Recoat with pale ivory lacquer and let dry for two hours more.

Use a delicate shade of blue, made by adding a little rich blue to white lacquer, to "highlight" such parts as may seem desirable, just to give a suggestion of decoration. Avoid overdoing this work.

If a very smooth finish is desired, the lacquer coats should dry overnight and then be rubbed with felt, FF pumice stone, and water. After the work is complete, the job should be washed, allowed to dry thoroughly, and then cleaned up with an oil polish or liquid wax.

Varnish or enamel may be used in place of brushing lacquer, and most readers are so familiar with their application that no suggestions are necessary except that plenty of time should be allowed for one coat to dry before applying the next, and the work must be given a light sanding between coats.

The design for the dresser was prepared by George F. Kaercher, the list of operations by Charles A. King, and the finishing specifications by Ralph G. Waring, each a specialist in his particular field.

This cutter is quickly sharpened



JUST feel the edge of a Sargent cutter when you've rubbed it up a bit. "Sharp" is the word. It's the chromium steel that does it—the unusually tough and wear-resisting steel which permits the use of a thinner and more quickly sharpened blade.

But that's not the only reason why this particular Sargent cutter is so easy to sharpen. This chap is using an Auto-Set—which has a time and labor saving feature

found in no other plane. *The cutter may be removed and replaced without changing the original adjustment.*

The Auto-Set together with the small steel block plane should be on every school and home work-bench. They are lasting and inexpensive—costing less than you would expect to pay for the planes that so many professional carpenters use. See them at your hardware dealer's and write us for descriptive booklet.

SARGENT & COMPANY, Manufacturers, 50 Water Street, New Haven, Conn.

SARGENT
PLANES



Sargent Steel
Block Plane
No. 5235



Sargent Auto-Set
Bench Plane No. 714



Outdoor sport with a real "kick"—at 1¢ a mile!

GET ready fellows—Spring's just around the corner. Prepare now for those glorious days of outdoor fun. Whether you like hunting, fishing, camping, touring, let an Indian Motorcycle be your guide.

Only 1¢ a mile! No traffic to worry you—no parking problem—no garage bills. Restful comfort—easily handled—smooth—rugged—flexible—and trusty as your closest pal!

There's an Indian model for every type of rider. Through the Indian Club Plan only \$1 starts you, and then easy payments. Send for free illustrated catalogue of 1927 models or better still, visit your nearest Indian Dealer for a free demonstration.



Celebrate
with us
Indian Day
February 22nd

A big party is being planned at the store of your nearest Indian Dealer. Come and bring the ladies! Music. Fun. Surprises galore! Valuable souvenirs for everybody.

Indian Motorcycle Co.

SPRINGFIELD, MASS.

Dealers

A few good territories open. Our proposition is a winner for ambitious men. Mail coupon now.

INDIAN MOTORCYCLE CO., Dept. H-3,
Springfield, Mass.

- ☐ Send me Free illustrated Catalogue describing the 1927 Indians.
☐ Check this square if you are interested in our money-making proposition to dealers.

Name.....

Address.....

City..... State.....

Age 12 to 16 ☐ 16 to 20 ☐ over 20 ☐

Mail Coupon

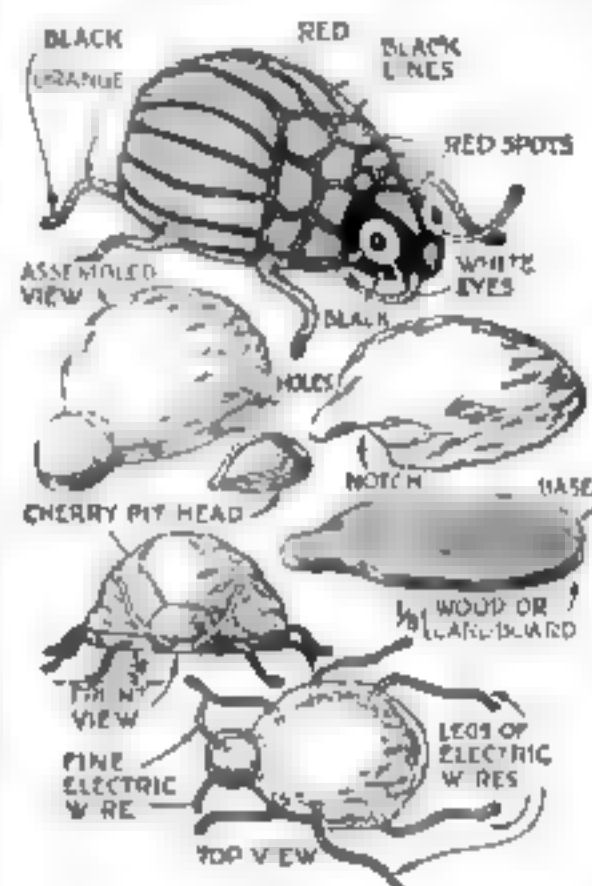
and please check nearest age to help us suggest the correct model for your requirements.

Walnut Beetle "Comicull"

By F. CLARKE HUGHES

FOR making this ferocious-looking beetle you will need but half an English walnut shell, half a cherry pit, a bit of thin wood or cardboard, and a little wire, glue and paint.

The wood or cardboard is shaped as indicated, to suit the walnut shell. After notching the shell to fit the cherry pit,



A queer bug, easily assembled and painted. It amuses children and grown-ups alike.

the two parts are glued to the base and allowed to dry.

The legs and feelers are made of insulated electric (magnet) wire and glued into holes drilled into the edge of the base. When the glue has hardened, the beetle is ready for painting.

The whole model first should be painted red and after this has dried the stripes and markings may be added, as shown in the illustration above.

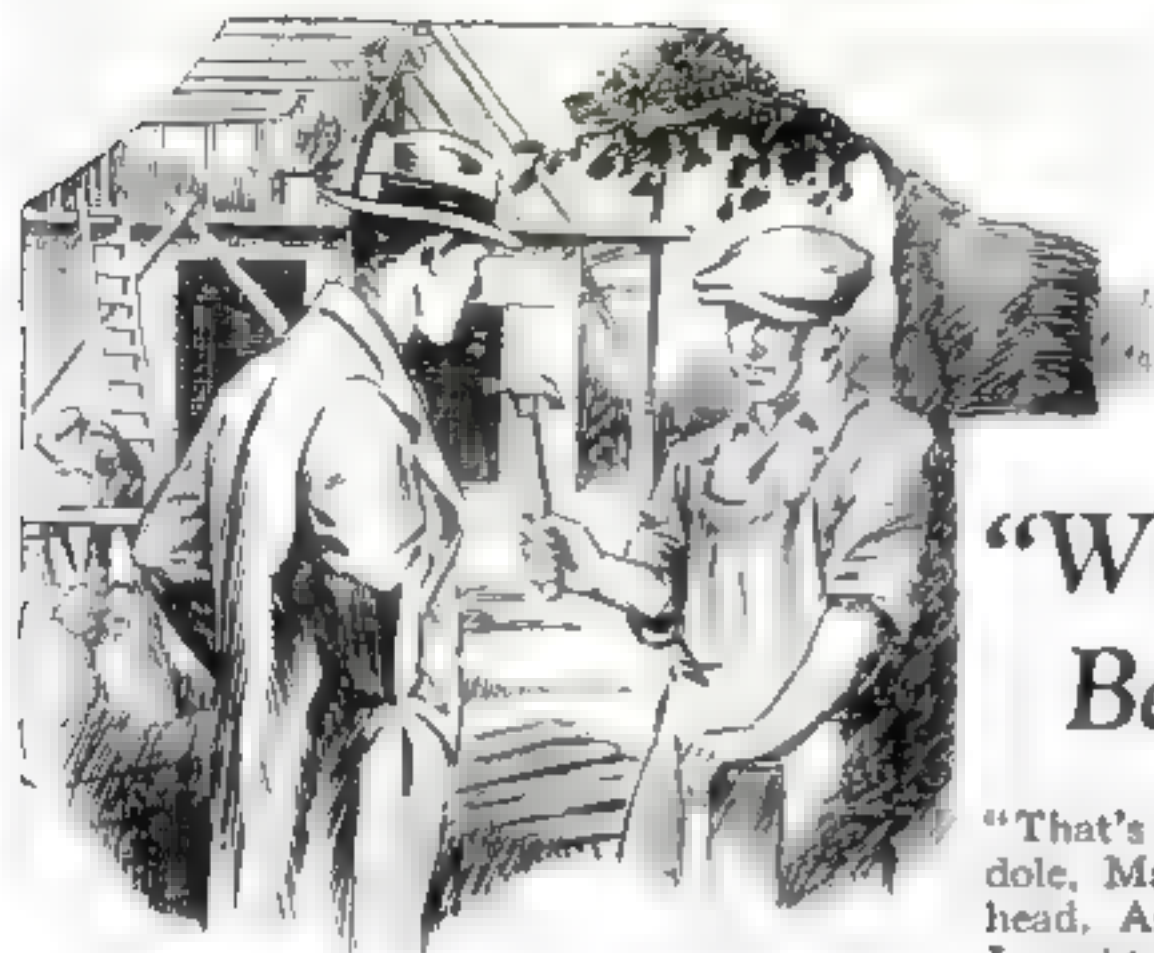
In the April issue Mr. Hughes will tell how to make small "comicull" tops.

Pad for Oiling Flat Tools

TO MAKE a pad for oiling saws and other tools that have flat surfaces, tear up strips of cloth of the proper width to go snugly into a shoe polish box, as illustrated, or use felt weather stripping. Place the roll in the box and pour machine oil on it.—L. L. MORROW.



A cloth roll coiled in a shoe polish tin



“What’s the Best Hammer?”

“That’s easy. The one with ‘D. Maydole, Made in U.S.A.’ stamped on the head. Ask me about some other tool and I might have a job deciding, but every man that knows tools ’ll tell you that there’s only one hammer with the ‘hang,’ strength and durability of a Maydole—and that’s another Maydole.”

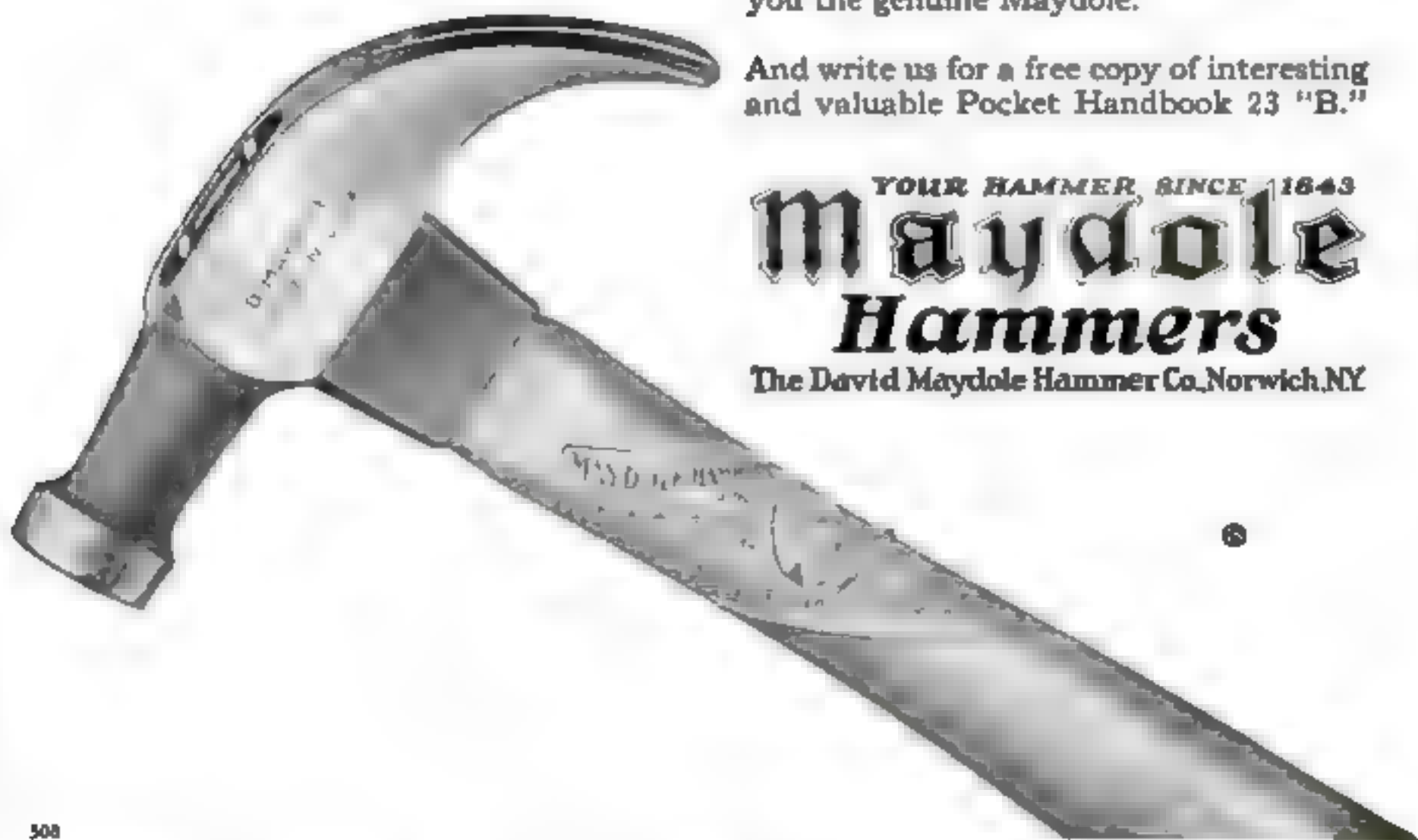
Maydole Hammers are the result of eighty-four years of accumulated skill and experience devoted exclusively to fashioning fine hammers. Heads are **press-forged** of tool steel; handles are of clear, second-growth, air-dried hickory, put on “for keeps.”

Maydole Hammers are made in all types and weights. Ask your dealer to show you the genuine Maydole.

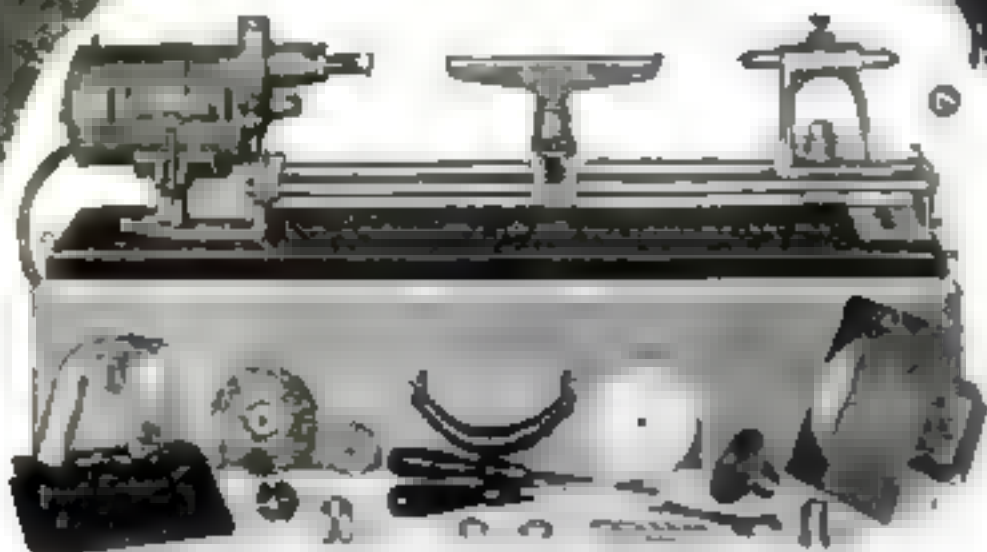
And write us for a free copy of interesting and valuable Pocket Handbook 23 “B.”

YOUR HAMMER SINCE 1843
Maydole
Hammers

The David Maydole Hammer Co., Norwich, N.Y.



10 Days Free Trial



Easy to Make things with Speedway Shop 8 Motor Driven Tools

Here is just what you have been waiting for! The big opportunity! The SpeedWay Shop is a compact and efficient electric workshop for you men who are "handy" with tools, mechanics, or experimenters!

The SpeedWay Shop is driven by the powerful back geared SpeedWay electric motor—famous the world over.

We are offering you the shop on a 10 day free trial in your own home. Test it! Experiment with it! Use it as you would your own! You will find it the handiest, fastest metal and wood working outfit you have ever laid your eyes on.

Only \$10 Down—balance easy payments

You can do buffing, polishing, grinding and drilling either at the bench or wherever you find a lamp socket and—all of this for only \$10.00 down—the balance on easy terms.

Fascinating! Intriguing! Interesting! That's what users say about the work you perform in your own home or shop.

You can make almost anything—attractive, odd furniture, toys, home and garden improvements, radio manufacturing, consoles, bric-a-brac, book shelves—countless useful articles.

Portable

Attaches to any light socket and converts a work bench into a complete private tool and machine shop. Packs into pressed steel carrying case as shown above. Use in basement or garage—anywhere there is current.

A blueprint a month FREE!

Each month for a year we will furnish you with a blueprint of your own selection free to help you to get maximum service from the SpeedWay Shop and Tools. Write for a list of the interesting blueprints we have for you.

Complete

A complete wood-turning lathe, bench saw, scroll or jig saw, a portable electric hand saw, and all accessories for both portable and stationary power.

drilling, buffing, grinding and cleaning.

ONLY \$10.00 DOWN

Don't hesitate. We want you to know more about the SpeedWay Shop and Tools. Every tool in the "Shop" is high-grade, built for regular work. A money maker for the small job man. A pleasure for the householder.

Get the full particulars. Send in the coupon today. Want a shop? It's easy to own one. We make it easy to pay while you enjoy a SpeedWay Shop right in your own home.

ELECTRO MAGNETIC TOOL CO.

Dept. 53—1830 E. 52nd Ave.,
CICERO (adjoining Chicago), ILLINOIS

SEND COUPON NOW

Electro Magnetic Tool Co., Dept. 53
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Dear Sir: Please send me full particulars about your 10 Day Free Trial, Free Blueprints and your new \$10.00 Down Payment plan on the SpeedWay Shop.

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Duplex Outlets Are Easy to Install

By GEORGE A. WILLOUGHBY

Supervisor of Electric Work, Arthur Hill Trade School, Saginaw, Mich.



Fig. 1. After removing the cover from the old receptacle, take out the screws

MANY homes have too few electric service outlets. In cases where the outlets are of the single receptacle or screw type (Fig. 1), they can be replaced quickly and economically with duplex convenience outlets of the type illustrated in Fig. 2.

First open the main house switch. Then remove the cover from the old receptacle and take out the screws with which the wires are attached. Be careful not to break the wires.

Remove the terminal screws from the new duplex outlet, put them through the loops on the ends of the wires and screw them firmly back in place. Attach the outlet to the outlet box with screws, making sure it is adjusted straight, and fasten on the new cover plate with the special brass screw provided for that purpose.

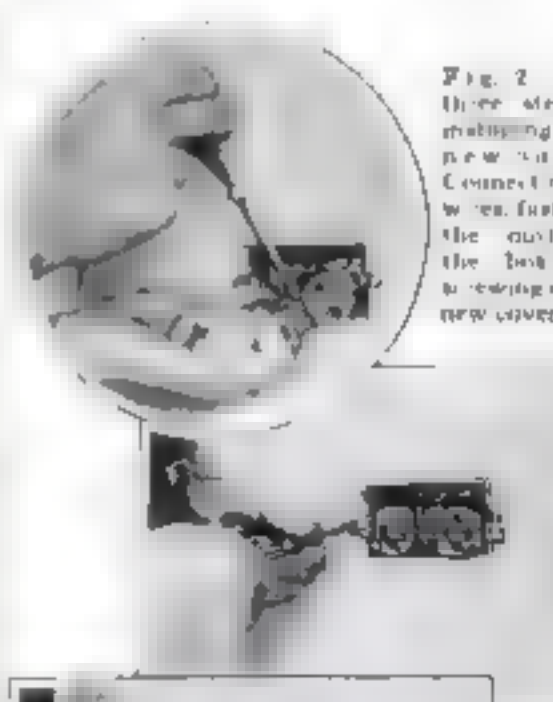
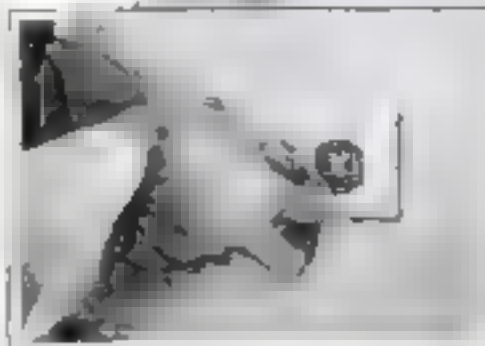
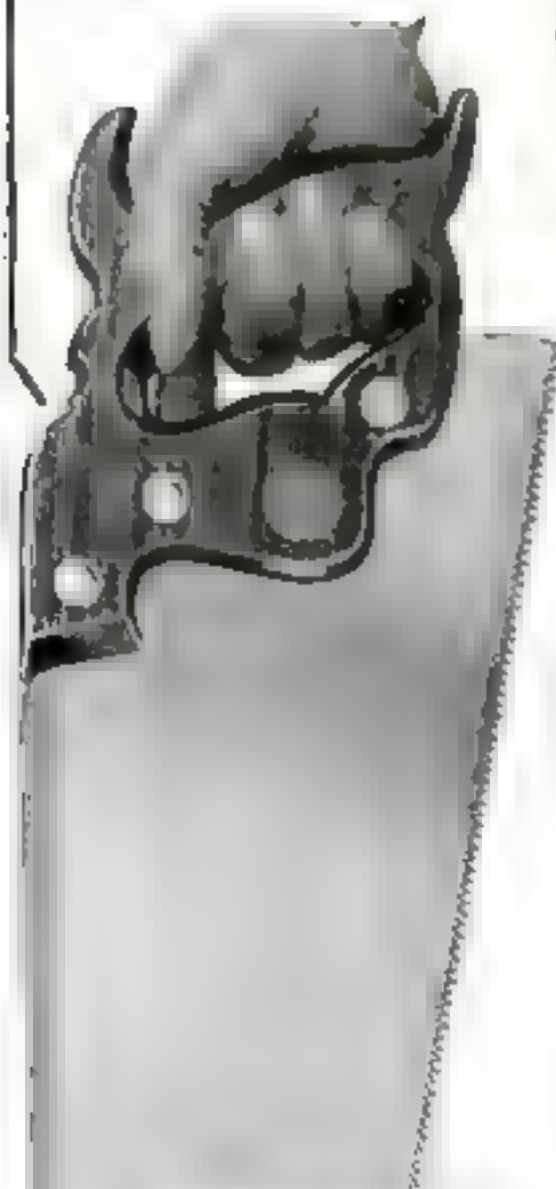


Fig. 2. The three steps in installing the new outlet. Connecting the wires, fastening the outlet to the box and screwing on the new cover plate.



ATKINS

SILVER STEEL SAWS



"Atkins '400' World's Finest Hand Saw"

ATKINS No. 400 is the aristocrat of all the ATKINS line—the finest saw that bears this world-famous name on the blade.

Only ATKINS Saws are made of Silver Steel to hold their edge through a long series of sawing. "Paper cutting" makes ATKINS Saws cut faster and longer.

There is an ATKINS Saw for every job. For more information, write to E. C. Atkins & Co., 428 S. Ill., Indianapolis, Ind.

for Cutting
Wood or Metal
**FASTER, EASIER
and BETTER!**

EVERYWHERE men who know good tools use ATKINS Saws—and better hardware stores everywhere sell them.

YOUR dealer can show you an ATKINS saw for every wood or metal cutting job—a saw that will cut faster, easier, and do the work better.

Ask for "ATKINS '400'—the world's finest hand saw." Try it once and it will be your favorite saw *always*. No. 53 "Lifetime" Saw, and "Junior Mechanic" are other popular saws in the ATKINS line.

See the NEW "Silver Steel" Hack Saw Blades for hand use! They last *six* times as long as ordinary blades!

Write us for "Saws in the Home" or "Saw Sense"—helpful books on saws and their uses—sent you **FREE**, upon request.



E. C. ATKINS & CO.

Established 1857

428 S. Ill., Indianapolis, Ind.

Leading Manufacturers of Highest Grade Saws for Every Line: Saw Tools, Saw Operators, Powering, Trunking, and Machine Saws.



New Hack Saw Blades of "Silver Steel"

*Cut Twice as Fast—
Last Six Times as Long*

Now at YOUR Hardware Store—You can get the wonderful NEW Atkins Hack Saw Blades of "Silver Steel" for hand use.

Actual tests show these NEW blades cut **SIX** times longer than any ordinary hack saw blade. They hold their edge better, cut quicker, and leave smoother work and material.

It pays to be sure you have ATKINS in your home. A new era in saw development. Look for the counter display shown above—at your Hardware Store.

ATKINS SILVER STEEL
MADE IN U.S.A.



**Banish future
screen repairs**

—use Jersey Copper this spring

YOU can avoid
screen repairs for
many years to come!

The way is easy:
Just use Jersey Copper
Insect Screen Cloth
when you make new
screens or repair your
old ones this spring.
Then your screens
will last for years and
years.

The reason is simple: Copper
is a durable metal—and Jersey
Copper, which is 99.88% pure,
will actually outlast the screen-
frames.

Jersey Copper Insect Screen
Cloth alone is made of Roebeling
Copper Wire. The special Roebeling
process produces extra strong
copper wire—unusually stiff, and
remarkably serviceable under the
severest conditions.

Save future trouble and ex-
pense. Don't use an inferior
screen cloth such as painted or
metal-coated steel. Don't use so-
called "bronze"—a variable mix-



ture of copper with
zinc, the wires of
which lack uniform-
ity in weather resist-

Pay a little more
and use Jersey Copper
in your screens. No
alloy cheapens it and
lessens its durability.

Only Jersey Copper
is a lasting protection
for your home. You can keep
screens of Jersey Copper out all
year around. Winter won't
harm them.

When you call at your hard-
ware merchant's, ask to examine
Jersey Copper in the roll. Look
for JERSEY Tag on end of roll.
Specify 16-mesh (recommended
by U. S. Public Health Service).
Order dark finish—nearly invis-
ible, and stays that way on ex-
posure to the weather.

Write for free booklet which
explains how to save money by
avoiding mistakes when you
screen your house.

The New Jersey Wire Cloth Company

650 South Broad St., Trenton, N. J.

All Grades of Wire Cloth Made of All Kinds of Wire

Jersey Copper

INSECT SCREEN CLOTH

MADE OF ROEBELING COPPER WIRE—99.88% PURE

"OLD IRONSIDES"

(Continued from page 84)

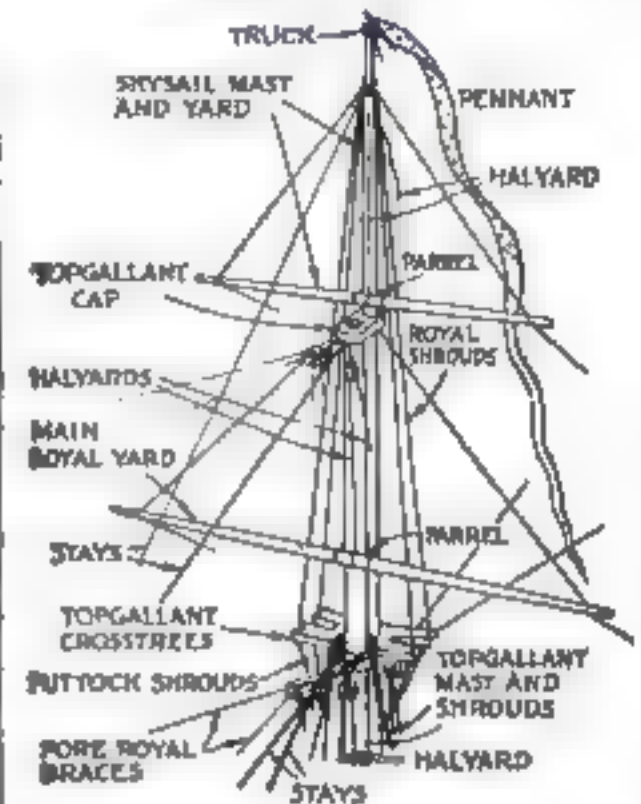


Fig. 6. How the rigging is completed
from topgallant crosstrees to main truck

to fasten them permanently; they are
useful also as lightweight clamps.

The wires or cords leading down from
the lower deadeyes are called futtock
shrouds, and the cords from them to the
deck, the bentuck shrouds. The futtock
shrouds also should have ratlines.

Before the topmast stays are set up
the jib boom will have to be slipped, but
first the spritsail yard, or spreader. It
lashes with a cross lashing under the
bowsprit between the deadeyes of the
bolstays (Fig. 4).

The jib boom has a nick cut in the
inner end to lie on the cleat; it reeves
through the hole in the cap and is lashed
to the bowsprit, just above the cleat.
The light of the foretopmast stay goes
through the crosstrees, behind the mast,
and the two ends go through the holes
in the bees on the bowsprit end (Fig. 5)
and tie underneath. The standing jib
stay is seized at the same place at the
masthead and comes through a hole near

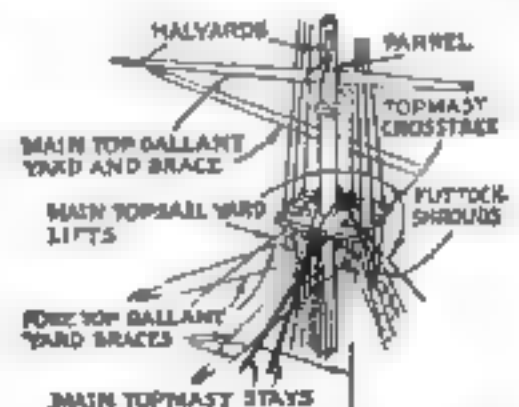


Fig. 7. This is the section of the mast
immediately below that shown in Fig. 6

the boom end, down through the top hole
in the dolphin striker, for the present it
will be left slack.

To steady the spritsail yard, hitch a
cord to the boom end (Fig. 4), then to the
yard one third the way out, and through
the inner hole in the cathead, to which it
may be set up with deadeyes or fastened
with a glued (Continued on page 88)

STAR HANDY GUIDE for HACK SAW USERS

★ HAND BLADES

Material to be cut

SPECIAL FLEXIBLE

Length	No. of Teeth	Order No.
6"	14	814SF
8"	14	814SF
10"	14	1014SF
12"	14	1214SF
6"	18	818SF
8"	18	818SF
10"	18	1018SF
12"	18	1218SF
6"	24	824SF
8"	24	824SF
10"	24	1024SF
12"	24	1224SF
6"	32	832SF
8"	32	832SF
10"	32	1032SF
12"	32	1232SF

FLEXIBLE BLADES

Length	No. of Teeth	Order No.
6"	14	814F
8"	14	814F
10"	14	1014F
12"	14	1214F
6"	18	818F
8"	18	818F
10"	18	1018F
12"	18	1218F
6"	24	824F
8"	24	824F
10"	24	1024F
12"	24	1224F
6"	32	832F
8"	32	832F
10"	32	1032F
12"	32	1232F

ALL HARD

Length	No. of Teeth	Order No.
8"	14	814
8"	14	914
10"	14	1014
12"	14	1214
8"	18	818
8"	18	918
10"	18	1018
12"	18	1218
8"	24	824
8"	24	924
10"	24	1024
12"	24	1224
8"	32	832
8"	32	932
10"	32	1032
12"	32	1232

Large Stock

Ordinary Work or General Use

Pipe, Drill, Plates, etc.

Thin Pipe Light Sheets, etc.

★ POWER BLADES

HEAVY—ALL HARD

Length	Gauge	No. of Teeth	Order No.
12"	18	10	1230
12"	18	10	1210
14"	18	10	1429
14"	18	10	1410
16"	18	10	1610
17"	18	10	1710
18"	18	10	1810
21"	18	10	2110
24"	18	10	2410
12"	18	14	1239A
14"	18	14	1439A
16"	18	14	1615
17"	18	14	1715
18"	18	14	1815
21"	18	14	2115
24"	18	14	2415
14"	16	8	14 90
16"	18	8	16 50

LIGHT—ALL HARD

Length	Gauge	No. of Teeth	Order No.
12"	21	14	1252
12"	21	14	1242
14"	21	14	1442

Ordinary Work or General use

Light Structural Shapes, Pipe, etc.

Heavy Structural Shapes and Sawing

Large Solid Stock

• All Hand Blades are 23 gauge—except Special No. 1420 for Large Stock which is 22 gauge.

A heavy ten-tooth power blade in cutting machinery steel, large angles, etc. big bar and rivet work.

An eight-tooth hand blade, a good all-around saw for general work.

This thirty-two tooth blade is used for cutting extra fine work, has fine cutting and sharp metal.

Use
This
Chart

WHEN BUYING HACK SAW BLADES

5 points of the Clemson Star

CLEMSON EXPERIENCE 120 years of the continued experience of the Clemson family.

CLEMSON STEEL Special Tennessee Steel made to exact specifications and current manufacturing processes.

CLEMSON TEETH The correct angle and rounded gullet of the teeth give them the maximum cutting ability, strength and endurance.

CLEMSON SET The teeth are set in a manner to maintain the proper clearance, to keep the cut free of chips.

CLEMSON TEMPER The heat-treating method used gives STAR blades an extraordinary degree of strength, smoothness and uniformity.

Every STAR Blade is branded with a STAR.

THIS condensed chart shows the proper hack saw blade to be used in cutting operations on the materials most frequently used.

Different blades are required for different types of machines. Be sure you are using the right type of blade for the work you are doing. If the work, or the type of machine you are using, is not shown in the above chart, write Hack Saw Blade Headquarters for full information as to the blade you should use to get the greatest speed and efficiency in your production operations.

Since 1883—for 44 years—we have concentrated on the efficient and economical production of hack saw blades on a volume

basis. This concentration has resulted in the production of a hack saw blade that eliminates the great waste of breakage... a blade that will do the toughest work. Star blades have gained their prestige by reliable, dependable performance.

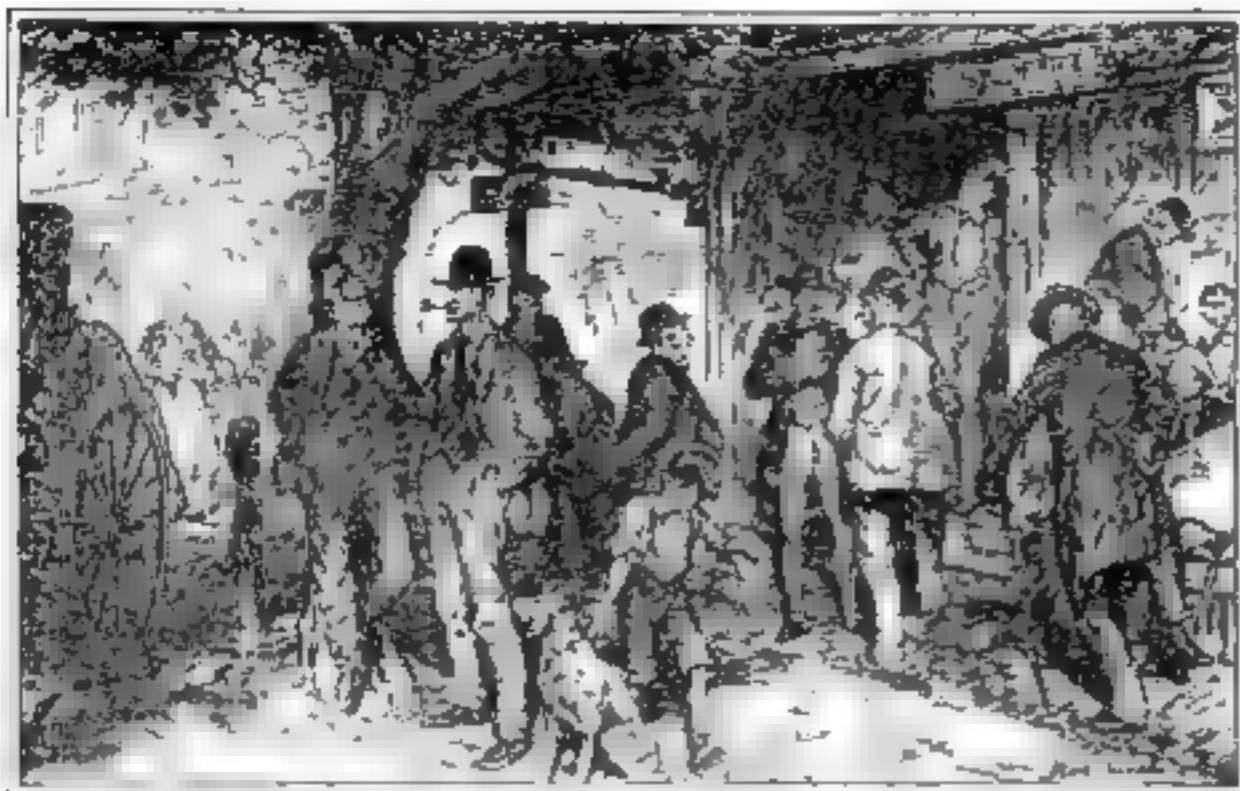
From years of experience, our engineers can show manufacturers new, economical methods on jobs where hack saw blades are used.

A letter telling us about the operations you use hack saw blades on puts you under no obligation—and may save you a great deal of money. Why not write Hack Saw Blade Headquarters to-day—the 2c stamp may save you \$200 to \$2,000.

FREE.—Let us mail you our large hack saw chart to be placed on your wall for handy reference.

HEADQUARTERS for HACK SAW BLADES
Since 1883
CLEMSON BROTHERS, INC.
MIDDLETOWN, NEW YORK

STAR HACK SAW BLADES



The Meeting Place

*An Advertisement of
the American Telephone and Telegraph Company*



It is not so long ago since people met in town hall, store or at the village post-office, to talk over matters of importance to the community. Then came the telephone to enable men to discuss matters with one another without leaving their homes.

With the growing use of the telephone, new difficulties arose and improvements had to be sought. Many of the improvements concerned the physical telephone plant. Many of them had to do with the means of using the apparatus to speed the connection and enable people to talk more easily.

This need for improvement is continuous and, more than ever, is a problem today. Speed and

accuracy in completing seventy million calls daily depends upon the efficiency of Bell System employees and equipment as well as upon the co-operation of persons calling and those called and numerous private operators.

It is not enough that the average connection is made in a fraction of a minute or that the number of errors has been reduced to a very small percentage.

The American Telephone and Telegraph Company and its associated Bell Telephone Laboratories have practically for their sole task the making of the telephone more serviceable and more satisfactory—as a means of conversing with anyone, anywhere, any time.

"OLD IRONSIDES"

(Continued from page 96)

wooden peg, the latter being the simpler.

The main topmast stay is hitched or seized to the fore lowermast under the cheeks, around the masthead and back to the hole abaft the lower cap. The mizzen is a single cord from the mizzen cross-trees to the mainmast.

The lower yards (Fig. 5) may now be swayed aloft. They hang by rings from the caps, all are similar, so one will be described. Reeve a cord up through the slot in the top, over the cap and down again, seize the two ends around a heart (which is somewhat like a deadeye but with one big hole). Through this heart and the staple in the yard pass and fasten off a lashing so that the yard will hang about 1 in. below the top. Around the yard and the mast pass a cross lashing for a parcel. Fasten a block at each yardarm and another on each side of the cap. Pass a thin cord from the bottom of the top block through the outer one, through the top one and down to the fife rail, haul both tight with the yard horizontal and the sling stretched, and belay (fasten the end).

THE lifts from the lower yard at the mizzen are carried to belaying pins in the small pulleys under the mizzen rigging.

The blocks are little wooden pulleys, with a hole in place of the wheel (sheave). They are best made of box or holly wood and should be in sizes from $\frac{1}{2}$ to $\frac{3}{4}$ in., or as small as you can make them (Fig. 3). The cord for the running gear should be an unbleached lumen about half as thick as the last mentioned, or, say, four leaves of this magazine, a light head-twist will do.

The standing rigging is that which does not run through blocks, and the running rigging that which does. All of the former should be dyed black before use; the latter is white or light brown.

The topgallant masts now should be shipped (Fig. 7) in a similar manner to that employed for the topmast, except that there are only three shrouds on either side, the ends of which are lashed to the topmast shrouds, below the cross-trees. Ratlines may be used.

THE fore topgallant stay is reeved through a hole in the jib boom just outside the last one and through a hole in the opposite leg of the dolphin striker; the two ends are then brought up and tied tightly abaft the cleat on the bowsprit. The other stays can be seen on the plan (Fig. 1), they are double at the main and single at the mizzen.

The topsail yard halvards (Fig. 8) are a bit complicated. Seize the bight of a thin cord to the heel of the topgallant mast, bring the two ends through blocks lashed to the yard on either side of the mast, then through blocks under the cross-trees on either side and seize blocks in the ends to lie a little above the lower caps; through these reeve a light cord, which may be fastened off to the neck of one of the lower after deadeyes of the lower rigging. The lifts are light black cords, which pass between the masts, the ends being (Continued on page 100)

Make More Money

Read the Money Making Opportunities on pages 134 to 166 of this issue.

Build It Better with a Boice!

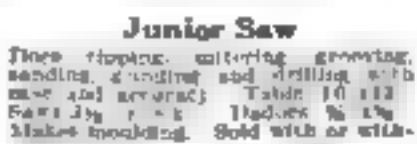
Men everywhere are finding it easy to buy a range of wood with Boice-Bench Machine. Send for the Boice's new 64 page booklet containing helpful information and describing Boice-Bench Machine, Hand Saw, Joiners, Jigsaws, Lathes, Drills and Motor Tools.



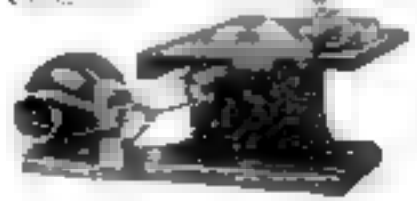
14" Band Saw
Table 22" x 14"
11/2" dia. 1/2" dia.
Horse 7" stock
Two blades 1/2"
to 1/2" wide
Bronze Bearings



8" Bench Lathe
Does turning, drilling, threading,
sanding, grinding, planing and (if
sawing in wood or soft metals).
Swings 8" Capacity 15" between
centers



Junior Saw
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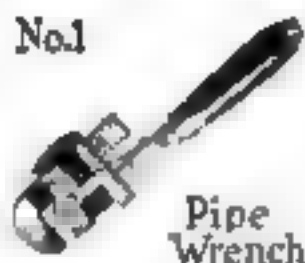
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Original Snip

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Slip Joint Pliers

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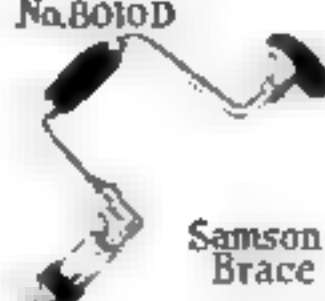
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Drawknife

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Auger Bit

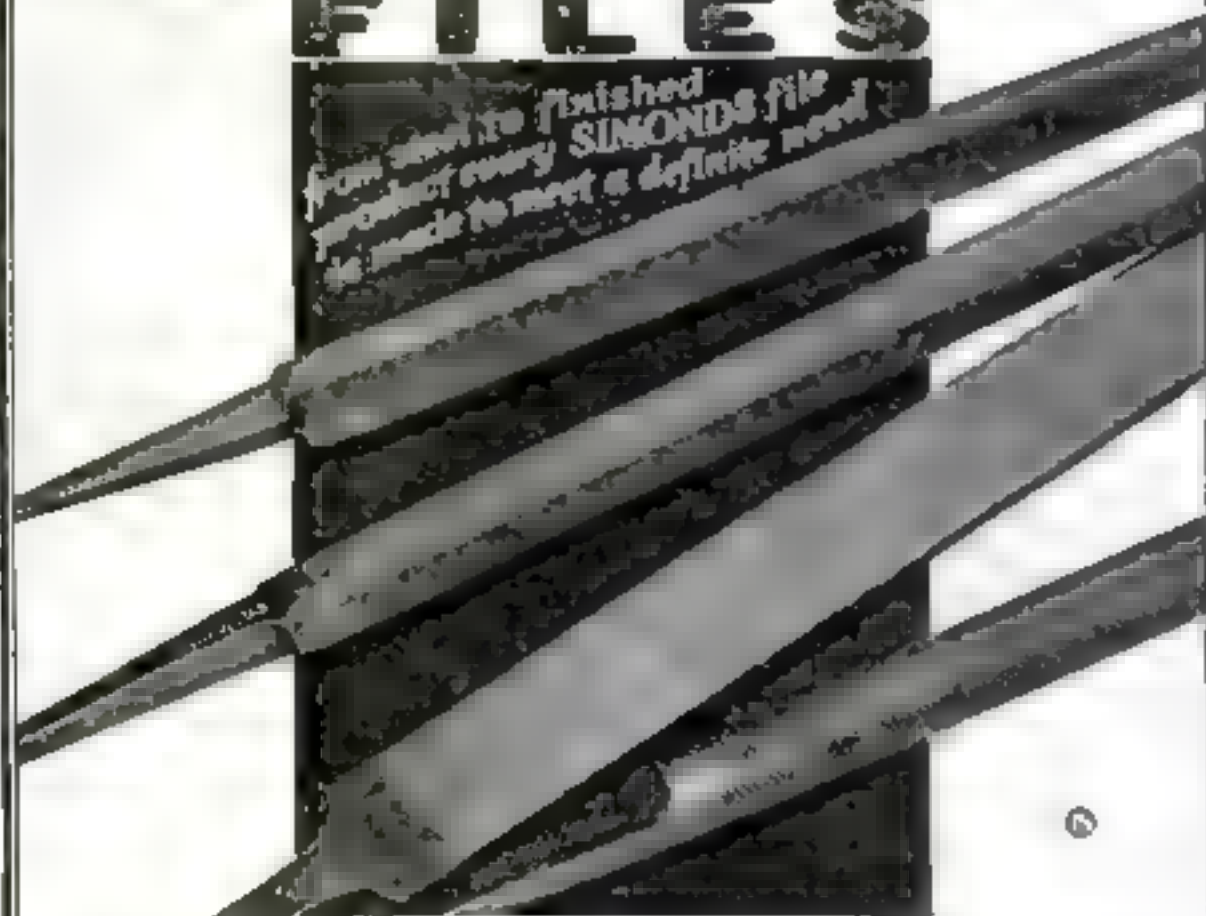
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Simonds' experience, made from Simonds' files, for the last 90 years, is the basis for the Simonds' reputation for quality and reliability. The Simonds' files are made to meet a definite need, and are backed by a near-century's experience.

"The Saw-Makers" SIMONDS SAW AND STEEL CO., Fitchburg, Mass. Established 1833

"OLD IRONSIDES"

(Continued from page 98)

pegged-off to holes in the yardarms. These and all yards are lashed to the mast as with the lower yards.

The topgallant yards are hung in the same manner, except that a single block on the yard and on the fore side of the crossrees will be sufficient, with one end leading down to a single block, the running parts of which lead to the rigging on alternate sides, fore to starboard, and so on.

The royal yards are the same (Fig. 6), but the halyards may be hitched to the center of the yard and pass through a single block at the masthead and from there direct to the deck, on opposite sides to the topgallant halyards. These yards should have the lifts hitched to their ends, because they are too small to bore.

THE flying jib boom (Fig. 4) comes next. It has a nick at the heel to take the edge of the cap as it is lashed to the jib boom. At the positions indicated the boom guys are hitched to it, to the sprit-sail yard and to holes in the cathead. The outer jib stay (from the topgallant masthead) is hitched to it rather more than half way out, and to the same place hitch the bight of another cord, the ends of which lead down through the dolphin striker and back to the cleat.

The skysail masts are shipped abaft the royal masts, and double throughout the length of the latter. A single thread through the masthead will be enough for their halyards.

The fore royal and skysail stays pass through holes in the end of the flying boom, in the slots at the end of the dolphin striker (sometimes called the martingale boom), and back to the same cleat as the others. These two stays at the main and mizzen may be the one cord, from one masthead through the upper crossrees and back to the other masthead.

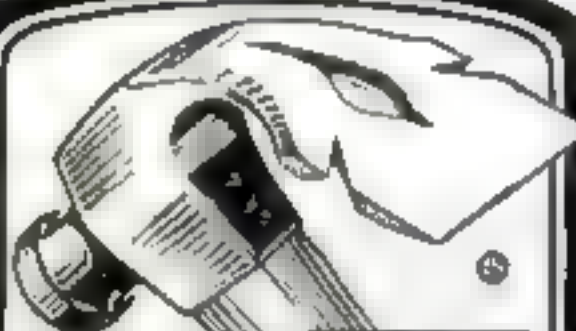
THE spanker boom (Fig. 1) may be fastened to the mast with a double pointed nail $\frac{3}{4}$ in. from the deck. It is supported by a cord, the bight of which passes through a hole 1 in. from the end and through blocks suspended from under the top on either side, and down to the rigging.

The gaff is fastened in the same way to the mast $\frac{3}{4}$ in. below the top, and is suspended by a cord starting $\frac{3}{4}$ in. from the end and passing through a double block at the cap, through a single block 2 in. from the end, back through the upper block, and to the deck.

At the latter position on the gaff fasten a block on either side, through which cords reeve to the cleats in the bulwarks.

Under the boom fasten a double block, and a single block to the deck, right aft, amidships. A cord comes from the cleat on one side through the top block, through the lower, through the top one and to the opposite cleat, for the boom sheet.

The spars being all in position, there remain the braces to reeve; these maintain the horn. (Continued on page 102)



A Claw-Hammer and Cutting Tool in One

THE chisel edge on the end of the claw makes this hammer a cutting tool of a fine red steel, without losing the claw feature. So a single tool may be used to pull nails and cut corners. The offset position of the head gives greater leverage, pulling or prying with ease. A perfect tool, and a fine hammer, forged of tool steel. If your dealer cannot supply you write us at once.



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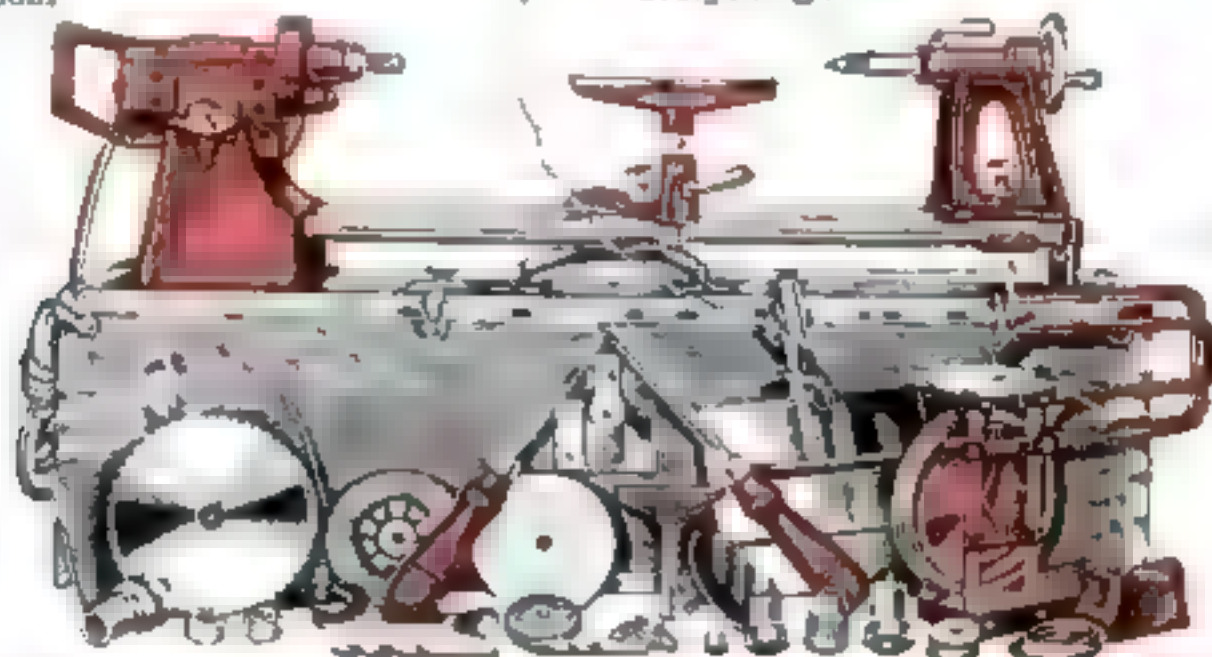


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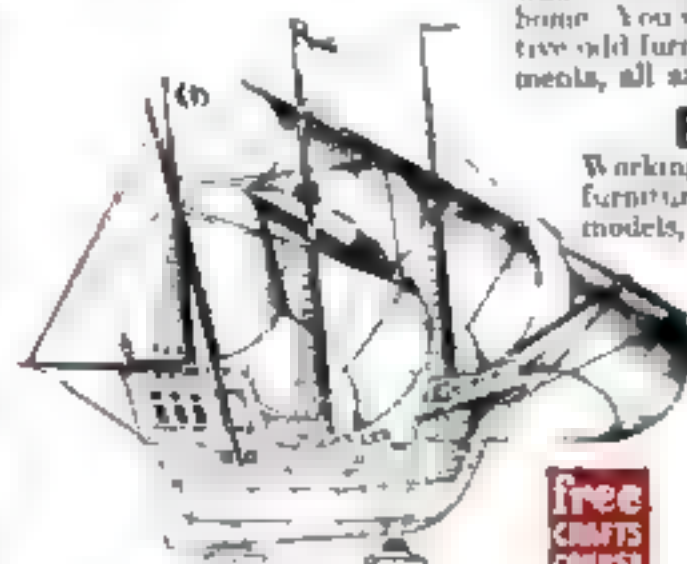
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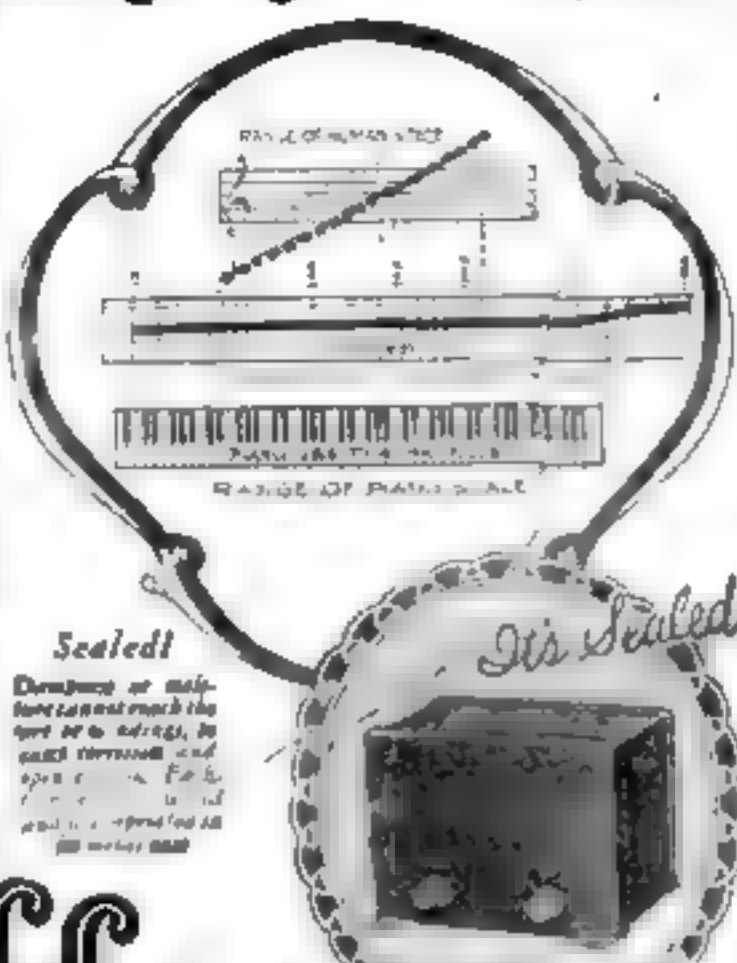
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Bring the Musical Quality of your Radio up to 1927

THE chief difference between your present set and one of the latest design is—tone quality. This you can quickly remedy without rewiring or changing the circuit. Merely replace the old audio transformers with Jefferson Concertones and enjoy the most lifelike, modern-day reproduction of programs!

These new large new Jefferson Concertones evenly and faithfully amplify all voices and all instruments. Their musical range is complete. They do not lose, distort or "reduplicate" sound from the lowest (30 cycles) to the highest (3500 cycles). Ideal for safe, continuous use with high-voltage power tubes. Unaffected by hot and cold climates. Fully shielded in handsome green enameled metal cases.

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Largest manufacturers of small transformers
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Sealed!

Drawings of this type cannot reach the top of the range, in fact, the range is from 30 to 3500 cycles. It is a complete range of sound. It is a complete range of sound. It is a complete range of sound.

Jefferson Concertone Transformers

"I Raze You!"

Welcome news! Here's Barbasol in my hand, and I hold a straight shave, full satisfaction, and four of a kind. No brush. No rub-in. No after-smart. No trouble. Try Barbasol—3 times—according to directions. 35c and 65c tubes.



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P.S.M. 3-27

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The Parks Ball Bearing Machine Co.
1547 Knowlton Street, Cincinnati, Ohio
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Montreal, Can.

"OLD IRONSIDES"

(Continued from page 147)

mental position of the yards. Start these at the top, with the thinnest cord, working down on alternate masts, using the middle grade of cord for the topsail and lower yards.

The royal and sky sail yard braces (Fig. 1) are single from the yardarms to blocks as close to the masts as possible. The other braces are double, the hight of them starting with a hitch on the indicated stay, through blocks lashed to the yardarms and back through blocks close to the masts. Note that the main topsail brace starts at the mizzen stay and leads up, and that the fore braces need second blocks in the rigging to lead them clear of the main yards. All the braces should be brought to the pinruls and there belayed, but in so small a model the royal and sky sail braces may be fastened off in the crossrees below their respective lead blocks.

ALL the deadeyes, and blocks, too, if you wish, should be painted black, also the wires for the chains, except where they cross the white streak, where they also should be white.

The main deck guns now may be pushed into position, and the frigate deck gun carriages glued to the deck. See that all the muzzles are on an even line. Put on the boats and steering gear. Bend a pin, hook it to the end of the anchor cable and push it into the hawse pipe. To the ring of the anchor fasten a double block, Reeve a cord through this and the holes in the cathead, and bring the end to the cleat in the bulwark. Then take the end round the anchor shank, the cleat, and the arm, and fasten off to the cleat.

Hook a light chain to a staple in the rudder just above the water line. Staple the lights under the stern and the ends at the quarters.

Hoist an ensign at the peak and, if you wish, a long red, white and blue pennant at the main (Fig. 6), and your model is complete.

ANY form of base can be used to stand it on. The simplest consists of two uprights on a board about 13 in. long by 4 1/4 in. wide. The shape of the uprights can be cut from two of the templates used for cutting the hull. Nos. IV and VII being the most suitable they should fit snugly so that the model will stand upright. The stern support must be cut lower than the other by a full 1/4 in., because it is the water line, not the keel, that must lie level.

Now if you have followed these instructions and the drawings carefully, working neatly and keeping down to scale, you will have a model of "Old Ironsides" far and away above the average in accuracy, appearance and value. The great majority of model makers do not start with the right data, therefore their models cannot be as good as yours even though you have not had the experience to put in as fine workmanship.

How to build a picturesque Viking ship model will be told in a series of articles beginning next month.

For Modern Shaving

LOOK!

Run Any Radio from your Electric Current

And remember, it makes no difference what kind or what make radio set you have, PHILCO Socket Powers will give you both A and B radio power from your electric light current—dependably and constantly. Here is your opportunity to do away with the ordinary "A" storage battery, dry cell batteries, and "B" batteries.

One switch controls everything. Snap it "ON" and from your house current you get a strong, steady flow of A and B power. Snap it "OFF" and your radio is silent.



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Philco Socket Powers will give you radio reception without the least hum; without the least distortion. Your electric lighting current will now operate your radio set smoothly and perfectly—any kind or any make of set.

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You can buy a PHILCO AB Socket Power on Easy Payment Terms from any Philco dealer in your town. You merely make a small first payment—balance monthly.

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No matter where you live there is almost sure to be an authorized PHILCO dealer near you who will deliver a brand new Philco Socket Power to your home on the day and hour you desire. He will connect it to your radio set at no additional cost to you.

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Visit the Philco dealer, or if you prefer, mail this coupon to us and we will give you the full details direct from the factory. We will send you complete information on our Easy Payment Plan and Trade-In Allowance offer for your old storage battery.

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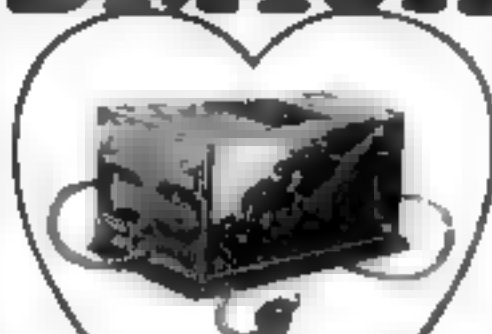
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The Ravages of Dry Rot

(Continued from page 74.)

that the fungus has set up a pipe line which carries its strand-like secretions from the earth or from some moisture laden base at the foundation. Research has shown that a 30-ft. lift is no strain on the capacity of the fungus.

Science has also demonstrated the cure for this hazard by showing that there is little danger of rot in a dwelling where the wooden parts are well clear of the earth or of all other possible sources of moisture and where there is sufficient under-ventilation to keep exposed wood from becoming damp.

The chief damage to dwellings is caused by what is known as dry rot, which is the type produced at distant points through the medium of the highly efficient conduit system of the strands of the fungus. The driest timbers are not safe when the dry-rot strands once reach them. The effectiveness of the moisture transport is shown by the fact that the timber 20 or 30 ft. from the source of dampness may become saturated and dripping through the steady

flow of water.



Courtesy L. S. Brach Products Laboratory

Dry rot strands will lift moisture 30 ft.

Sufficient records are available to indicate that preventable dry rot is costing the country many millions of dollars annually. In Alabama alone cases have been studied in fifteen cities and towns calling for repair at a cost of \$210,000—estimated at

one-twentieth of the total annual loss in that

State as a whole. This would indicate \$1,000,000 of needless yearly expense for the one state.

For his own protection it is important that the home owner should inspect every possible source of moisture—from basement supports to the attic. If the up-rights in the cellar gather dampness, he should treat them to the surgical operation practiced by my neighbor.

If he lives in a region of snows, he should see that the snow is kept away from his exterior lumber. The ideal thing is to have the foundation extend above the snow line, but in the case of a house already standing there is still the simple remedy of shoveling the snow away.

If the rot attacks the woodwork around the chimney, new metal flashings undoubtedly are needed. The roof valleys also should be given new flashings, if the old ones are in bad shape, and the whole roof kept in repair.

Conductor pipes and down spouts are a fruitful source of danger along the line of decay. The eaves trough may become a menace in any one of several ways—through leaks, through improper fastening which allows it to sag in places and

prevents free flow of water, or through becoming clogged with leaves. The householder's remedy is to remove the elements of danger before they have resulted in spreading moisture and starting pipelines of decay in the woodwork of the house.

The interior of the dwelling holds many places of possible infection. It may be that an examination of your bathroom flooring will show that there is serious decay around the water and drainpipes, this is of common occurrence. The remedy is easily applied and inexpensive. Remove the decayed wood and wrap the pipes carefully with asbestos or other insulation, carrying the insulation through the floor so that the pipes will have no contact with the lumber. This will prevent the trouble caused by moisture "sweated" on to the surface of the pipes through condensation.

AN ADDED precaution is found in the use of creosote on the woodwork surrounding and adjacent to the pipes. Creosote is the natural enemy of decay. Applied with a brush, like paint, it is highly effective in averting rot.

The pathologist will tell you—with scientific accuracy—that a can of creosote and a paint brush for its application form one of the best investments the home owner can achieve. It may be taken as a safe statement that all woodwork exposed continually to moisture should be creosoted. The most effective way of doing this is before construction, but the handy paint brush makes it possible to do it with excellent results in a house that is already occupied. One coat of creosote well applied will defer the danger of decay for several years.

IN EXAMINING his home the owner may find that posts and joists have their bases or ends matted into concrete. The concrete thus surrounding the timber may form a pocket which will hold enough moisture to make a base for a far-flung colony of fungi. Wherever possible the concrete should be removed sufficiently to destroy the pocket.

Where timbers are imbedded in the ground, it will be found useful to treat the surrounding soil with an antiseptic for the elimination of fungus. This may be done by applying hot creosote freely with spray or brush.

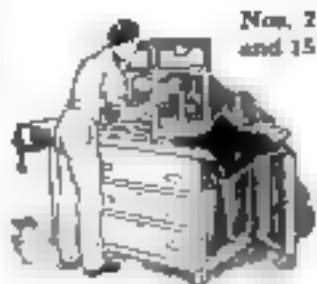
A constant lookout should be maintained for leaks around and under door frames and windows. These must receive prompt repairing, for neglect may easily start a long line of decay.

The fundamental rule of rot prevention is: Where infection occurs despite all precautions, the diseased pieces should be removed at once. Rot is progressive and infectious.

How to repair decayed sills and cracked siding is told on page 106 of this issue and an article on the patching of a shingled roof appeared on page 114 of the December, 1926, issue.

Blueprints You Will Find Easy to Understand

"AS FOR your blueprints, any child with common sense can understand them," writes J. W. Bertram, of Cranbrook, B. C., Canada. He would not exchange his electric washer and tea wagon (built from Blueprints Nos. 12 and 13).



Nos. 12
and 13

Complete List of Blueprints

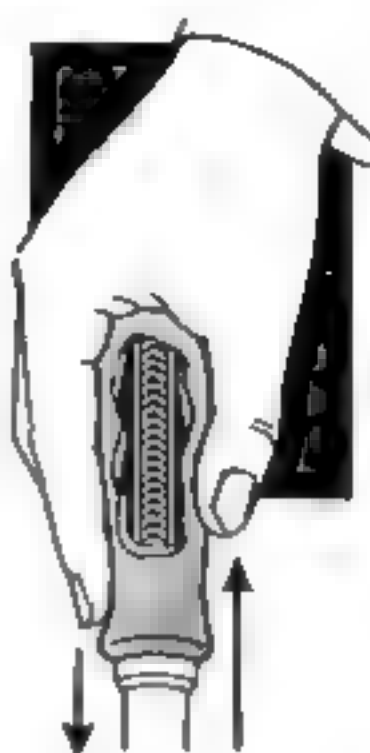
ANY ONE of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The corresponding back issue of the magazine, in which the project was described in detail, can be had for 25 cents additional so long as copies are available. The Editor will be glad to answer any specific questions relative to tools, material, or equipment.

POPULAR SCIENCE MONTHLY
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And the tension keeps blade in screw-slot, leaving one hand free to hold work.

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Right-hand Ratchet, Left-hand Ratchet and Rigid. Three sizes of bits.

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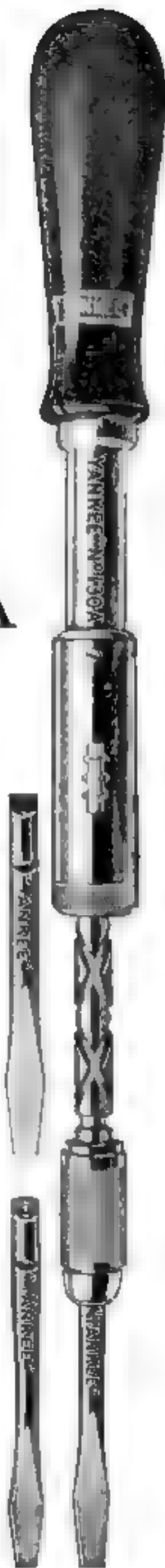
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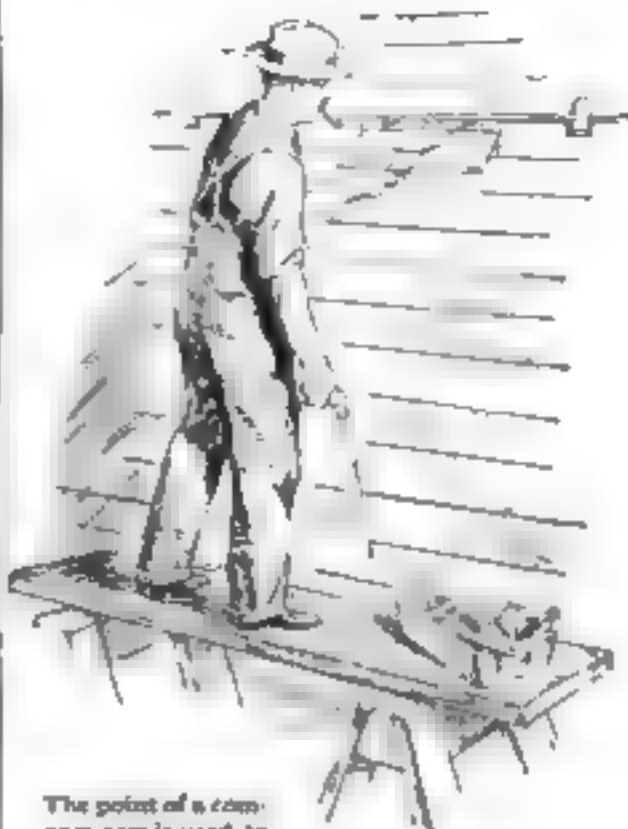


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The SHIPSHAPE HOME



The point of a compass saw is used to cut out the siding

By A. E. ELLING

SIDING, as the boards which cover the exterior of a frame house are called, rarely rot. Through long exposure, however, it becomes very brittle, especially if the painting has been neglected.

As moisture will enter in cracks in the siding and cause the paint to blister and peel, and possibly lead to serious rotting of the framework that supports the house, it is essential to make repairs promptly.

When many splits and loose nails are found, especially at a corner of the building where the corner boards show signs of rot, you may be sure that there is some

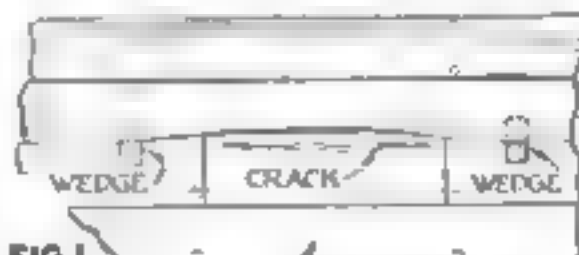


FIG. 1. BEVELED SIDING. $\frac{1}{4}$ ROUND

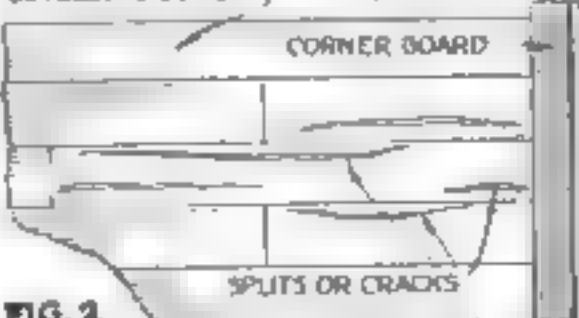


FIG. 2. CORNER POST SHEATHING

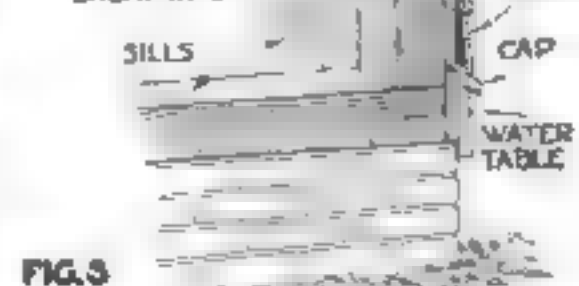


FIG. 3. Unless cracks in beveled siding are given prompt attention, the post and sills may rot

Making Repairs to the Exterior of a Frame House

opening which lets in moisture freely. This must be looked for and remembered. The opening may be quite a distance up, even at the roof gutter.

When the corner board is removed, often the corner post will be found rotted. If the plaster in the room inside is sound, it will not be necessary to cut a complete section of the post out. Chop out the rotted part roughly and patch the post with a piece of two by four or other rough wood. When a house has sheathing boards under the siding, the corner post may be decayed a little without greatly affecting its stability, but this is not true of the sills (Fig. 3).

If it is seen, after removing a piece of the corner board at the bottom, that the sill has rotted away, remove a section of the water table and bevel cap (Fig. 3) as far as the decay goes, and replace with a new sill, this usually measures 4 by 6 in. If the old sill is so badly decayed that the corner posts and studs have sunk slightly into it, the side wall should be jacked up while the new piece is inserted.

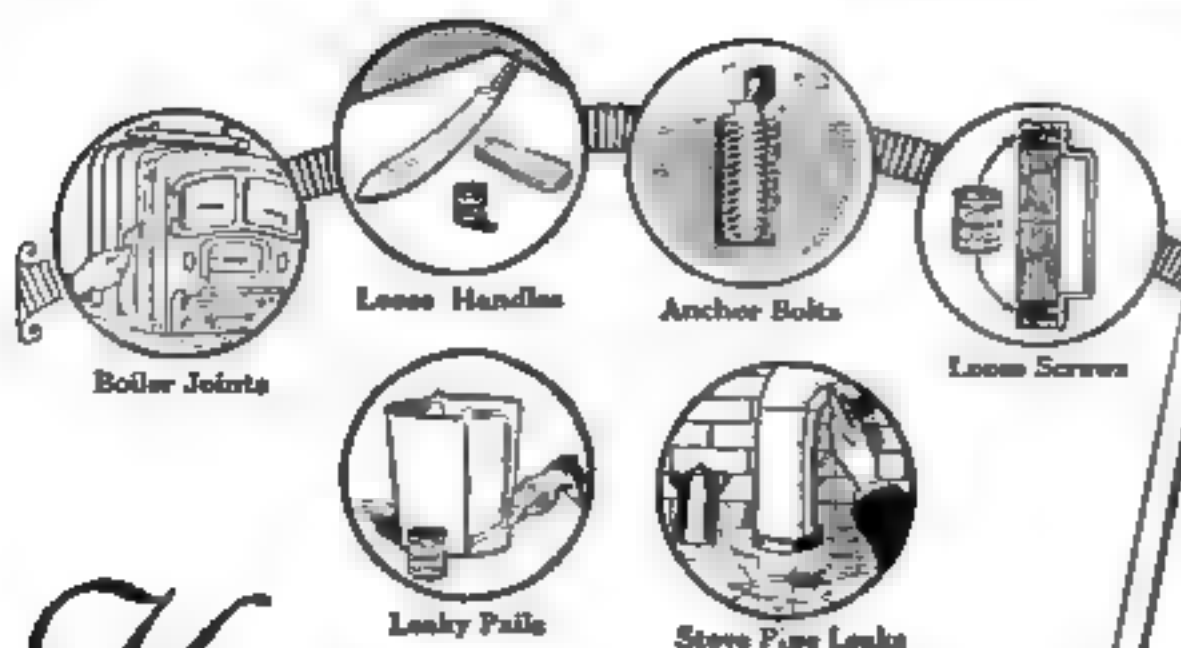
The difficulty in repairing beveled siding lies chiefly in removing the split pieces and the nails which hold them. Drive a wide, thin chisel or, better still, a thin iron pry bar gently under the edge of the piece just above the one which is cracked. Pry up about $\frac{1}{8}$ in. and insert two small wedges or blocks (Fig. 1). Then, with the point of a compass saw, cut out the piece to be removed, after marking guide lines with a small try-square.

WITH a cold chisel bend slightly each end passing through the piece of siding that has been raised by the wedges, then remove the wedges and tap the piece back in place. The heads of the nails will be forced through the surface so that they may be gripped with a claw hammer. Some mechanics prefer to drive the nails right through the siding with a nail set, but that leaves a large hole and had best be avoided wherever possible.

A new piece now must be marked with a square and cut to make an exact fit. Tight joints are imperative in this work.

If a number of pieces are to be cut out, one below the other, begin at the top. In no case in the finished work must one joint come directly over another; the joints must be broken as in Fig. 2.

As corner boards and quarter round molding are of varying dimensions, the new pieces will have to be made to match the old. Cut off the old corner board square across, but have the saw tipped upward, if possible, to give a beveled cut at the joint and, of course, cut the new piece to match. Set the nails for puttying and give a priming coat of paint at once.



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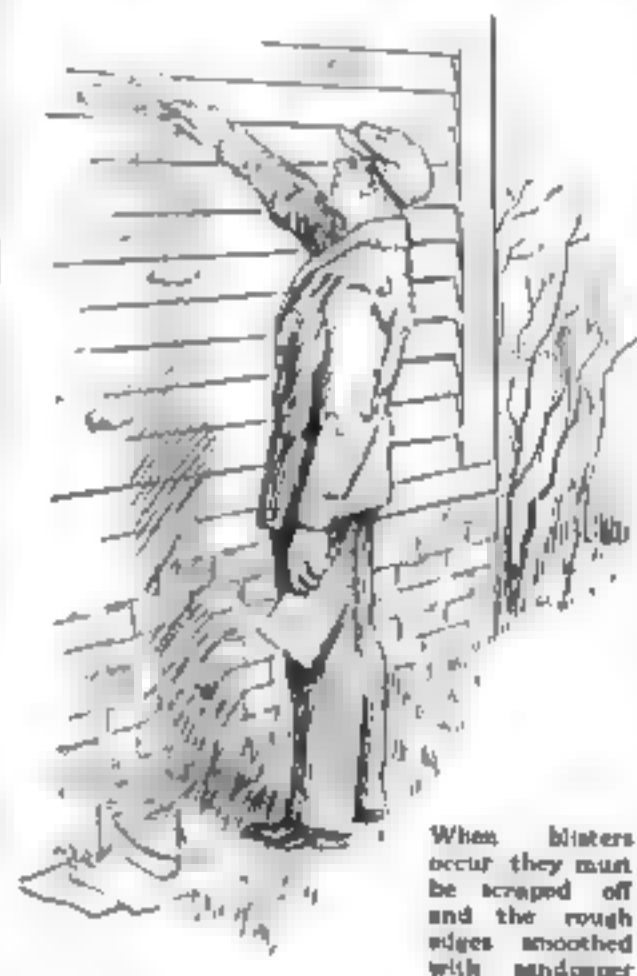
Outside Painting Troubles and Their Cure

By BERTON ELLIOT

"LET'S go over to the Andrews." I suggested to Mrs. Elliot one evening after dinner. "You know the last time they were over to get some information about painting, we had time to go over only two or three of their questions, and Mrs. Andrews seemed rather disappointed."

We were soon seated about the fireplace of our neighbors' home. Mrs. Andrews had the old familiar sheet of questions unrolled and ready for reference.

"First thing before we start down the list," I put in quickly, "I want to say a word about blistering, as this is a sort of



When blisters occur they must be scraped off and the rough edges smoothed with sandpaper.

first cousin to peeling, which we discussed so thoroughly before.

"Blisters are places in the paint film which become detached from the surface and puff out instead of peeling or scaling off. As a rule they occur only in newly applied paint. They are generally caused by moisture in the wood seeking its way out. The new paint film, being very elastic, stretches and expands into blisters. This form of trouble is most common in midsummer painting, when the heat of the blazing sun draws the moisture out and vaporizes it rapidly. Blisters often disappear in a short time, but nevertheless the paint still remains detached, and when the paint film becomes brittle it scales away.

"When repainting, all blisters should be opened up with the corner of a putty knife and all loose scales scraped off as far back as they can be. Otherwise you may have future trouble. The rough edges should be (Continued on page 109)

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Outside Painting

(Continued from page 108)

sandpapered down before applying the new paint. Now, then, Mrs. Andrews, let's have your questions."

"Well, here's the first one: I've noticed some houses where spots of different sizes appear after the paint has become dry. They are generally lighter than the rest of the paint and less glossy. You don't see this so often, but it looks very bad whenever you see it. What causes it?"

"THE appearance of spots—'spotting,' the painters call it—is generally caused by unusually soft and porous places in the wood, which draw in a great deal of oil from the paint. There is then not sufficient oil in the paint film to give it a gloss over these places. Where wood is seen to be of a very soft, spongy and porous nature, an extra amount of linseed oil should be used. As a matter of fact, the use of a generous amount of oil will assure freedom from many troubles. A scant amount of oil is always a trouble breeder. Oil, you know, is the element which gives paint a fine, rich gloss, and makes it last. Rapid loss of gloss indicates that not enough oil was used to bind the pigments properly."

"That is interesting," remarked Mrs. Andrews. "Who'd have thought there was so much to it. Now here's the next problem: The last time we had our house painted, there were some places on the back porch where the paint wiggled and squirmed about and didn't stay put. I didn't notice how the painter finally made it work, as I wasn't so much interested in painting then."

"THAT is called 'crawling,'" I replied. "It may be due to different reasons. One of the most common ones is a greasy or oily surface. That was probably the trouble in this case, as on many back porches there are old boards which are very greasy. Paint will not stick to greasy surfaces, and where it is known that the surface has been subjected to grease or oil, the best thing to do is to wipe up as much as you can with a cloth saturated with gasoline or benzene. Then scrub the boards with a strong solution of hot water and sal soda, and rinse off thoroughly with clear water. Be sure to let the boards become thoroughly dry before painting."

"Many times, however, crawling occurs where the surface is not saturated with grease or oil, and it is hard to trace the cause. It may be due to oily deposits that are not visible to the eye. It may be due to too much gloss in the undercoats. Sometimes it is because the surface is wet or cold at the time of painting. Of course, if you find that the trouble is due to a wet or cold surface, you can simply stop painting, or move to another side of the building, until the condition is corrected."

"If the reason is not apparent, try adding turpentine to the paint. If this does not correct the trouble, wipe over the surface with a cloth wet with high test gasoline, turpentine or naphtha. This will remove greasy substances, if any, and also cut the

(Continued on page 110)



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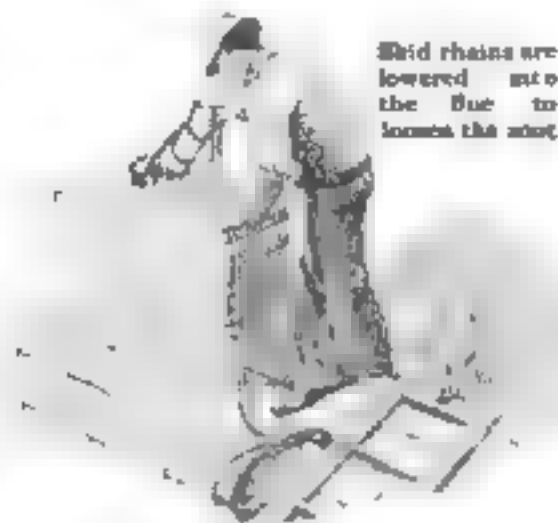
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Cleaning a Chimney

CHIMNEYS, especially those in soft coal districts, require cleaning from time to time. This is an unwelcome job for the home owner, but it can be



Skid chains are lowered into the flue to loosen the soot.

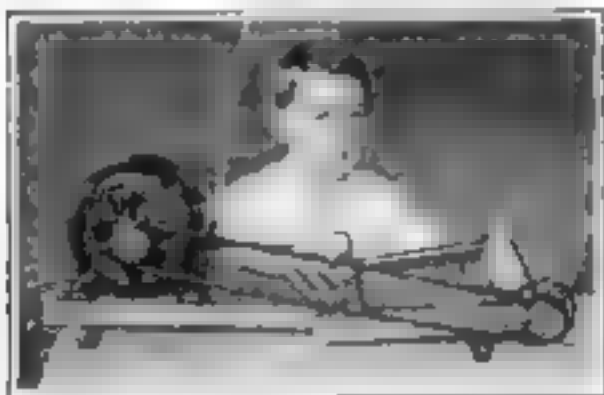
made easier by using a bundle of automobile skid chains on the end of a rope for scraping clean the flue.—J.D.G.

Homemade Floor Sander

From articles gathered up in my garage, I built the floor sander illustrated. A quarter-horsepower electric motor was taken from a small circular saw and fastened to a plank 1 1/2 by 12 by 36 in.

A wooden roller 3 in. in diameter was fitted with a 3/4-in. pipe through the center to serve as a shaft. Two 1 in. square arms of maple were made and bored to receive the ends of the pipe. Brass plates with corresponding holes were screwed to the arms as bearings.

A 3-in. wooden pulley to match the pulley on the motor was made and fastened on one end of the shaft. Then the



Floor sander made from scrap parts and run by a quarter-horsepower electric motor.

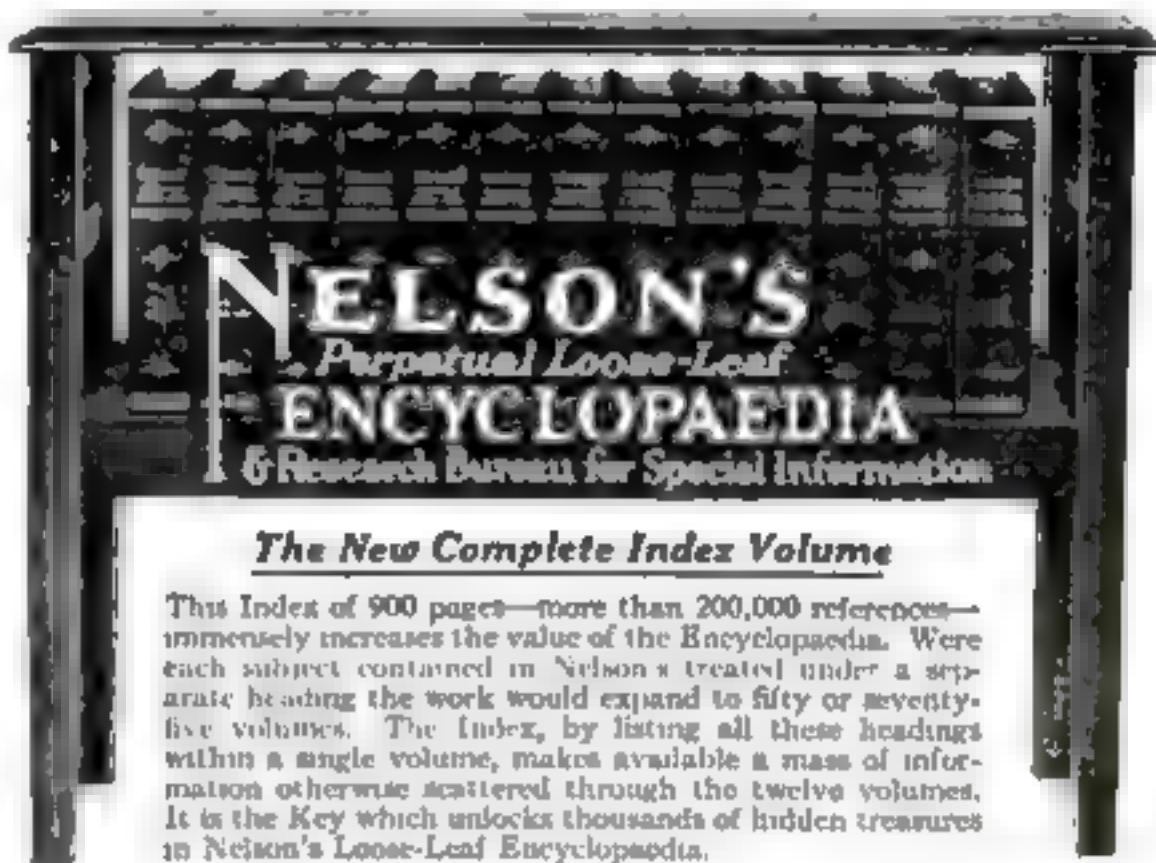
arms were screwed to the side of the plank at an angle, as shown. A cleat was fastened across the arms close to where they joined the plank. A wooden door bumper was screwed into the center of this cleat as a handle for guiding the sander over the floor.

After a groove had been cut lengthwise across the roller, five sheets of sandpaper were wrapped around and fastened with nails driven into the groove in such a way that their heads could not touch the floor. Four casters were placed under the plank to allow the sander to be rolled in any direction.

The motor turns the sandpaper roll at high speed provided the machine is not pressed down too heavily against the floor. —TRACY C. FRALEY

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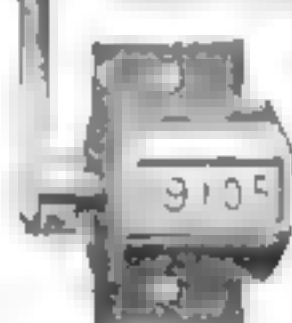
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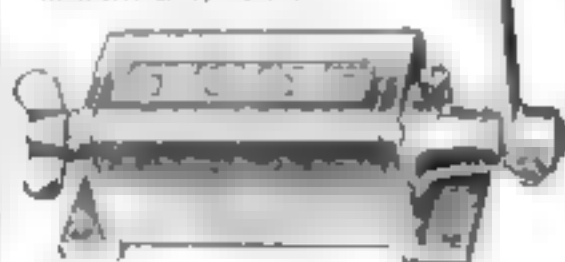
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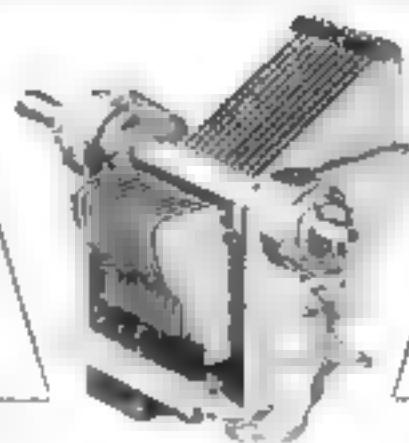
The model represents a staunch and colorful open boat such as that in which Lief Erickson is supposed to have made his hazardous passage of the Atlantic in the tenth century. The hull is 10 1/4 in. over all. The prow and stern stand high; shields with gay Celtic devices line the rails, and the single large square sail is brilliantly striped and emblazoned. The lines of the hull are from the "Gokstad" ship, which was dug up in Norway and now is in the University Museum, Christiania.

He Built a Little Circus

"I finished my sixty-five wagons," Joe says, "and the twenty tents, and a hundred and sixty-five horses and the animals—making horses and animals out of mel-thick pine with jigaw and carving tools. I laid away saw, lathe, electric motor and automobile emblems (for the equipment has the best paint possible) and sought to solve the lighting problem. The real big show carries its own electric lighting plant. I talked with electricians about gasoline engines, dynamos and conduits, and they all told me that I could not get steady light from any engine and dynamo I might pick up at a price within my means. But I refused to give up. Finally a good angel in the person of the owner of one of Rockford's largest knitting mills heard of my dilemma and presented me with a dynamo and engine. The latter is of the two-cycle type—muffled, at the neighbors' request, with an old ord muffer. After fourteen hours of running with changes of pulleys on both engine and dynamo I was able to hook up the one hundred and fifty lamps which light my tents and circus 'lot'."

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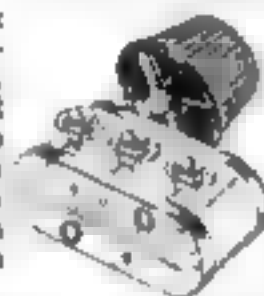
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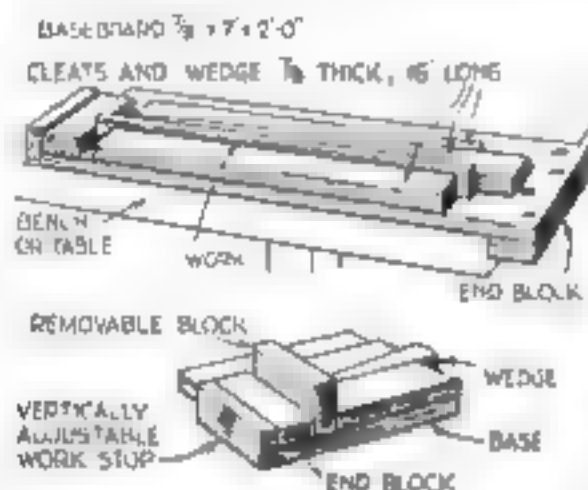
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Bench Board for Kitchen Table

EVEN a kitchen table can be used as a bench for light woodwork if a combination bench block of the type illustrated is made. It serves as a sort of a vise—a bench stop, a “shoot” board for planing end grain, and a regular bench block for sawing, planing and various other purposes. For any light work such as building ship models, constructing



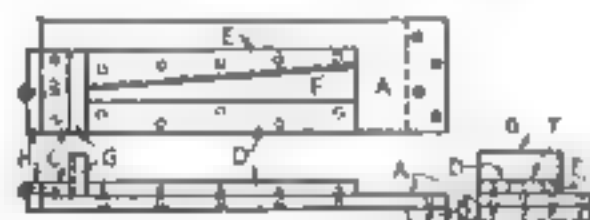
This ingenious fixture serves as a vise “shoot” board, and regular bench block

toys and for making small repairs, it is invaluable wherever a well equipped bench is not available.

The block is made of $\frac{3}{4}$ -in. hardwood, preferably maple, birch or oak. It consists of a baseboard, A, 7 by 24 in., with a block, B, $1\frac{1}{4}$ by 7 in., screwed under one end and a block, C, $1\frac{1}{4}$ by 5 in., on the upper side at the other end.

A piece $5\frac{1}{4}$ by 16 in. is sawed in three parts to form guides D and E and wedge F. The saw cut dividing E and F should be made at an angle so as to form a dovetail slide, this makes it impossible for the wedge to rise even under great pressure and jarring. Stock which is to be held for planing the long edges is placed along side D, with one end against C, and clamped by means of wedge F.

It will be noted that parts D and E are kept back $\frac{1}{4}$ in. from C. That is so that the loose block, G, $2\frac{1}{4}$ by 5 in., can be inserted in the slot thus made when the board is to be used as an ordinary bench



Top, side and end views of the bench block, which is made of $\frac{3}{4}$ in. thick wood

block for sawing and chiseling and as a “shoot” board for planing the end grain of small pieces. In the latter process, the plane is placed on its side on the baseboard A and is held lightly against guide E. The work rests across D, E and F and is held firmly against G.

Block H, $1\frac{1}{4}$ by 5 in., is fastened so that it may be raised above the surface of C, when necessary, to serve as a stop for planing thin wood. L. G. FELLOWS.

Another type of kitchen table workbench will be described in an early issue.

\$2750 in 39 Cash Prizes

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Space does not permit giving details of this WEATHERBEST Old Home Remodeling Contest or possibility of your winning a prize, but if you have an old home in need of repainting or repair, write for Booklet “Making Old Houses into Charming Homes” and Bulletin giving details of this contest. Let us explain how the WEATHERBEST Stained Shingle Remodeling Service Department, by furnishing sketches and making suggestions, will help you make practical changes that in this contest may win a cash prize greater than the cost of remodeling or reshingling with stained shingles. This service neither obligates you to enter this contest nor to purchase any special materials.

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Use the coupon today and determine the practical possibilities for remodeling your old home. Entrants for contest may be made any time prior to Aug. 1, 1927, and work finished before Sept. 30, 1927, after which date the following judges will award prizes as early as possible: Bernard L. Johnson, Editor American Builder, Robert Taylor Jones, Technical Director Arch. Small House Service Bureau, L. A. Martin, Architect, C. Paxton Cody, Reg. Archt. and Pres. Penn. Assoc. of the A. L. A., C. M. Caswell, Vice Pres. Kasey Realty Co.

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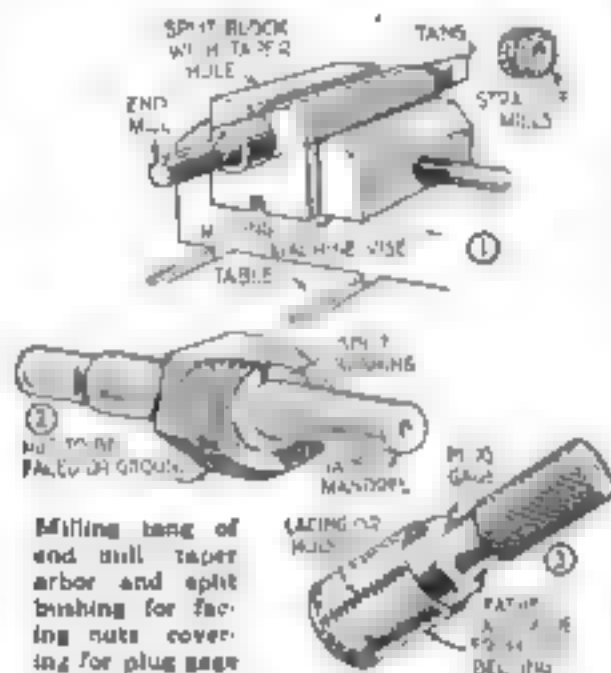
ADDRESS.....

Machine Shop Kinks That Save Time

By W. L. MILES

SUCCESS in the machine shop is founded upon the ability to make every little detail count. In the course of many years' experience, a number of little time-saving kinks have helped me, some of which follow.

Where tangs are to be milled on end mills, ards, or other taper shank tools, a split block having a taper hole as in Fig. 1 is a useful fixture. This enables the tang

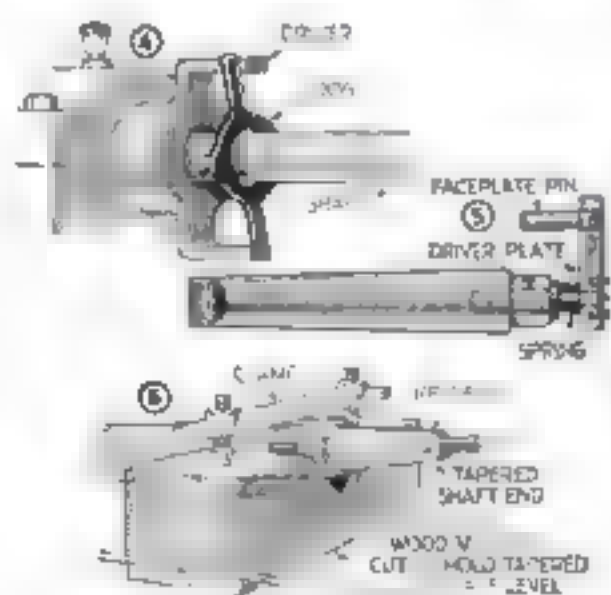


to be milled with straddle mills, in just half the time required if each side were milled separately. The front end of the work is brought against a stop—a bolt with collars—on the milling table.

For first class work where nuts are hardened and the faces ground, or even when they are to be faced in the lathe the mandrel shown in Fig. 2 is to be recommended. A split threaded sleeve fits on a taper mandrel, thus locating the nuts by the thread only. The bushing is $\frac{1}{8}$ in. shorter than the nut, which is screwed on approximately central before the taper mandrel is pressed in.

Machinists using plug gages will take better care of them if there is a leather cover made from old belting to protect them from scars when not in use (Fig. 3).

Where there is much small work to be turned between *(Continued on page 116)*



Two types of time-saving drivers for small work, a wooden V block for tapered shafts

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Machine Shop Kinks

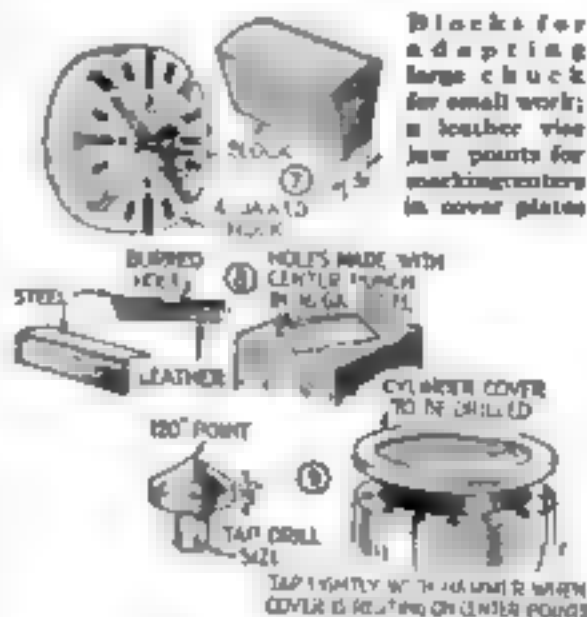
(Continued from page 115)

centers, the two-pronged driver and the double-tailed dog shown in Fig. 4 will save time.

Another type of driver, this one for the grinder, is shown in Fig. 5. This is for work of the character of piston pins, where slots are cut in the end for driving. It fits on the live crater, and has a spring to force the pins that actually do the driving to engage the work.

Many machinists do not appreciate the use of wood in making temporary or emergency fixtures. For planing keyseals in the tapered ends of shafts, hard wood V-blocks can be used as in Fig. 6.

If every lathe had a large chuck and a small one there would be no need for the kink illustrated in Fig. 7, which shows



some small beveled pieces to enable small rods to be gripped in a large four-jawed chuck. I have sometimes used $\frac{1}{4}$ in. square key stock for this purpose.

Pieces of leather are often used around shops to prevent scarring work in vices, but more convenient to use are special leather jaws like the one in Fig. 8. Two pieces of sheet iron are punched as indicated over a block of wood so as to throw up burrs. These and the leather faces are put in position between the vice jaws and pressed firmly together.

Among the most useful devices are center markers for drilling holes in cover plates to match holes already drilled in cylinders or machine frames, as shown in Fig. 9. They are made of tool steel and hardened. The shank is made to fit the tap drill size. In use, a number of them are inserted in the holes to be matched, the plate put above and held in place while it is tapped lightly with a hammer to drive the points into the metal to make center marks. This is much easier than laying out the work tediously by hand or even making a paper template.

To make a reasonably accurate hole straight through a casting or piece of steel in the lathe, run a drill entirely through the casting about $\frac{1}{8}$ in. below the correct size. Then bore out this hole to the finished size about $\frac{1}{4}$ in. deep. Enter a drill the size of the finished hole into this bored-out portion and run it through the work. The result will be a straight hole close to the proper size.

This method is for holes that are small and too long to be bored.

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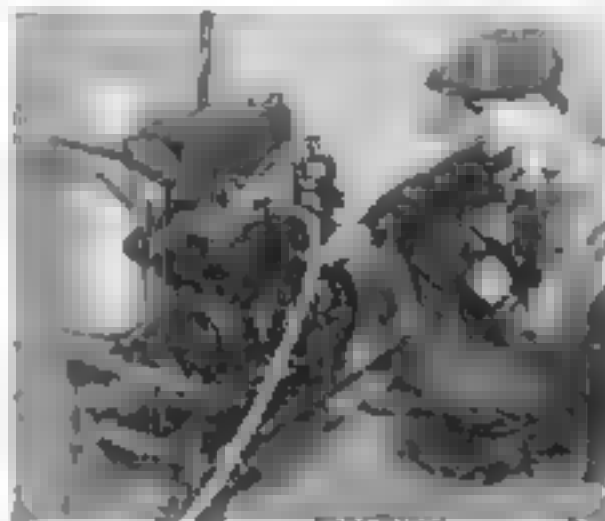
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Old Motor Transformed into Air Compressor

BY TRANSFORMING the two center cylinders of a four-cylinder gasoline engine into pumps and using the outside cylinders to furnish power, Harry Vickerman, of St. Paul, Minn., has built an efficient, compact air compressor at little cost.

A discarded motor was purchased for a few dollars and put in running order



The two inner cylinders act as air pumps and the outer cylinders provide the power

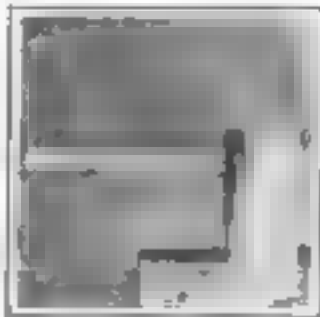
from odds and ends around the shop.

The combustion space in the cylinder head above those cylinders used as air pumps was filled with babbitt. Three holes were first drilled into the top of each combustion chamber and lapped for $\frac{1}{8}$ -in. screws. The heads of these screws were allowed to extend into the chamber a short distance so as to serve as anchors when the babbitt was poured in around them. A wooden plug was driven in the spark plug opening before pouring the babbitt; this kept open a passage through the babbitt for the air outlet.

The valves of the two center cylinders were bolted down to their seats and the push rods operating them removed. Pipe connections were made with the spark plug holes of the center cylinders and joined with a tee. A Y-coupling was connected with the tee. One side of the Y was fitted with an intake check valve; the other with an outlet check. An old water heater tank was pressed into service as a radiator. The compressor runs at approximately 500 revolutions a minute and easily supplies an air pressure of 125 pounds. —JESSE A. LEAMON

Unique Babbitt Ladle Has Spout Like Oil Can

THE tube arrangement on the side of this babbitt ladle is for pouring in awkward places. If the metal is to be carried any distance before pouring, it is well to warm the spout. —A. K.



A ladle for pouring in awkward places

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Ways to Save Money

(Continued from page 76)

would think that the designer tried to make it of solid iron instead of having pretty round holes and graceful curves like that old planer."

"Yes," Davis responded, "I know that old planer very well indeed. I spent many a day on it. I see that this is a modern

open-side one, so that it will easily handle awkward pieces like those that made us resort to so many ingenious tricks on the old machine."

"With the varied work that we do," Bascom said, "it seemed almost necessary for us to get the open-side machine, and now that they have been made so strong and rigid there was no reason for not getting it."



Fig. 4. Motor-in-base type surface grinder

"I have been looking at the controls," his friend remarked, "They seem to be all grouped on this side."

"Yes, the operator hardly has to move, except to set up the work, and where we have quantities, we can rig up fixtures that will take much of that burden off him."

Bascom went closer to the machine.

"**H**ERE is a lever that clamps the rail to the column with one motion. We used to have to go all around the old machine with a wrench to do what this one lever does. Here is another lever that runs the heads back and forth by power, for setting up, or at the end of a cut. And, of course, the heads have power feed in any direction. In fact, once the work is on the machine, and the tool in place, the operator need not leave his position. There is an oil pump to keep things properly lubricated. Everything is accessible."

"Very nice," Davis acknowledged approvingly. "All you have to do is to get my tool steel for it, and then watch it work. It would seem that you are getting a lot of new tools. You certainly believe in having things up-to-date."

"I spend about as much time in digging up new tools and methods as I do at anything else," Bascom replied. "The management looks to me for results, and usually all I have to do is to show them that it will be profitable to put in new tools. The buildings are crowded, so we have to use equipment that will really produce. If we can make one machine do what two did before, it is well worth our while to spend a little money and get the new machine. I will show you another machine as an example. The machine is new, but the interesting thing about it is the fixtures that we have put on."

"Here we are doing the same trick on a lathe that we have done before on miling machines and drill presses. That is, we have a fixture (Continued on page 120)



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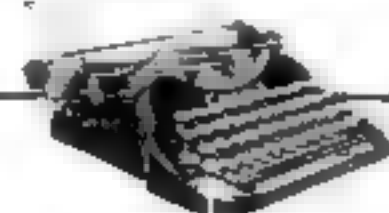
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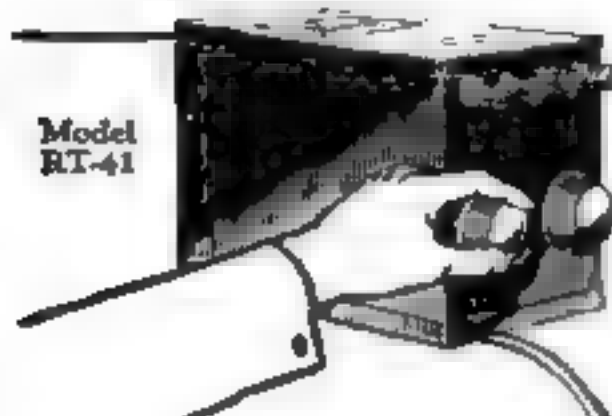
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Ways to Save Money

(Continued from page 119)

that locates the work so that more than one surface can be machined without re-setting."

It was a heavy turret lathe (Fig. 2). Mounted on the spindle was a fixture to hold the gate of a gate valve.

"The casting is put in the fixture," Bascom explained, "and one side machined in the usual way. Then, in place of unclamping and re-chucking the work, the chuck itself is indexed so that the other side is presented to the tools, and in exactly the proper relation to the first side. Just another example of putting skill into the machine."

"That's a great idea," said Davis. "There are very many parts alike on both sides that this outfit will handle."

"IT IS not necessary that both sides be alike," Bascom pointed out, "for there are enough stations on the turret for us to put in two sets of tools, one for each end of the casting."

"You may have noticed that these new machines are all motor driven. We are getting most of them that way now. If we go into the tool room, I will show you another surface grinder with an exceptionally fine arrangement for the motor drive. This machine has the motor hidden in the base, yet it is accessible for any



Fig. 3. Economy and increased grinding production are claimed for segmental wheels.

attention it may need, but is out of the way of falling objects, grit and water."

Looking at the front of this machine (Fig. 4), there was not a belt visible.

"I always expect to see the counter-shaft overhead, and two or three belts running down," Davis remarked. "This one looks as if something is missing. I suppose it is a sign that appearances of familiar machines may change with improved design."

Bascom opened a little door in the front of the base.

"There is the motor," he said, "and the belt is in the back. We can put the machine wherever we can run a wire. Even with the motor in the base, there is still room for storing tools under it."

He pointed to a compartment below the motor shelf.

Bascom led Davis through the rest of the plant. He was combining his usual morning tour of (Continued on page 121)

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SEA ARTS GUILD

605-N ELEVENTH AVE. MILWAUKEE, WIS.

Ways to Save Money

(Continued from page 120)

the shops with entertaining his friend. Soon they were in the shipping room (Fig. 1). Davis stopped and stood as though spellbound.

"What in the world is that?"

Bascom laughed.

"That, Henry, is our electric hand saw."

"It certainly does saw," Davis said and shook his head.

"Just another example of our effort to have things as up-to-date as we can. It has a small motor that runs off the light socket. It carries a nine-inch saw, large enough to cut through a plank three inches thick. This is a tool that will be seen often before long.

"We have had portable electric drills for many years, and this is along the same lines from the standpoint of utility. The makers say that it can be used for cutting through flooring where repairs to plumbing or wiring are to be made. We use it mainly for trimming crates after a machine is ready to ship."

"Walking through your factory is as good as going to a machinery exhibition," Davis complimented the superintendent.

"Well, we don't try to run a show, but after all, we do have things modern," Bascom replied. "It is out-of-date to use old machinery, and we no longer point with pride to tools that have been in use for twenty or thirty years. Each machine must stand on its merits here, and not on sentiment."

POPULAR SCIENCE MONTHLY will be glad to supply the names and addresses of manufacturers of devices mentioned in this article.

Buffing Wheel Used to Spin Nuts on Bolts Rapidly

AN INGENUOUS method of screwing nuts on bolts sufficiently tight to prevent their coming off in shipment is shown at the right. A small buffing wheel revolves the nuts after they have been started by hand.—P. M.

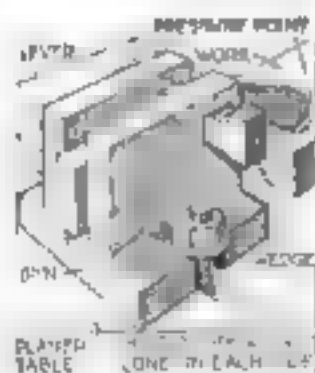
BUFFING WHEEL



NUTS BEING SCREWED ON LONG THREADED BOLTS

The wheel turns on two nuts at a time

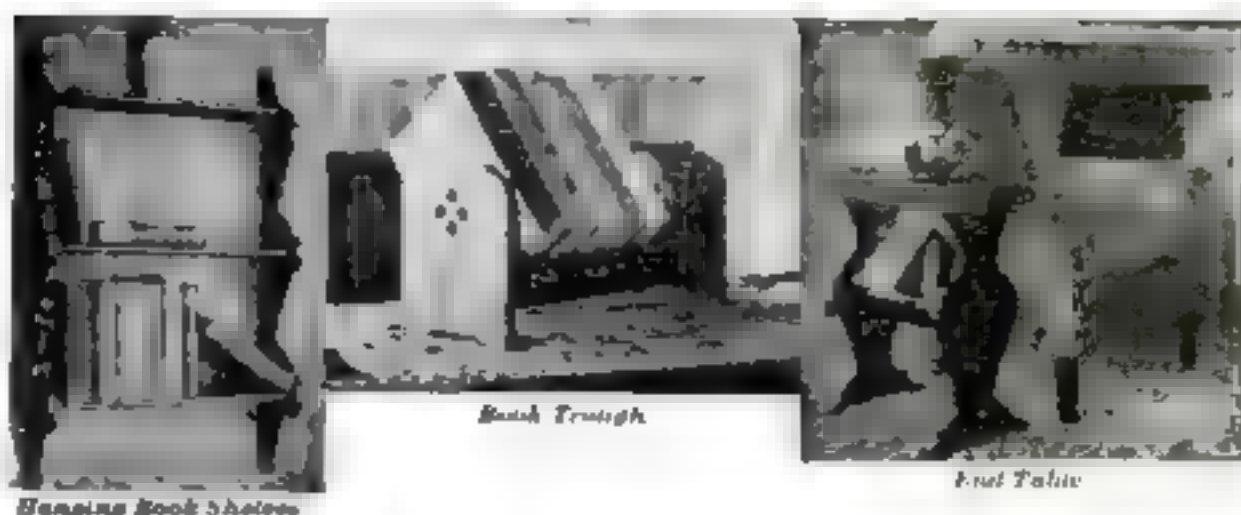
Quick-Acting Planer Clamp



The clamp is operated by a wedge

The wedge is not always appreciated as means for clamping work. It is quicker than screws and nuts. The illustration shows how a quick-acting clamp can be arranged to hold work on the miller or planer.—F.N.C.

Next month—an article on how to use recessing tools.



Hanging Book Shelves

Book Trough

End Table



Handiest Tool in your Work Shop

PERHAPS you have never thought of the special advantages of using LePage's Liquid Glue. It is always ready for immediate use. No weighing, soaking or heating is required. The quality is always the same. It "sets" slowly enough so that you have plenty of time to place the joints together exactly as they should go. Slow setting also allows LePage's to penetrate the wood, increasing the strength of the joint. LePage's Liquid Glue is equal in strength to any animal glue. Buy a can for your work shop. It is the easiest, quickest, handiest form of Glue. Fast on LePage's.

Recipe for making LePage's Gesso

To make one cup of LePage's Gesso you need 1 gal. can of LePage's Glue 1 1/2 cups white pig. 3 teaspoons linseed oil and 3 teaspoons varnish. Place white pig in mixing bowl and pour in slowly in this order: LePage's Glue, linseed oil, and varnish. Mix until smooth. All ingredients obtainable at nearest hardware store.

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LePage's "Practical Suggestions for the Home Work Shop" will help you come closer to equalling the skill of the trained cabinet-maker. It tells you how to make strong joints with glue, and with glue in its most convenient form—LePage's Liquid Glue.

This book also shows you how to cover up small defects in your craftsmanship. Now and then a tool will slip and an error is made. Or there are holes to be filled where nails or screws have been counter sunk. Or the edges of a joint are not exactly even. A simple new way to repair these defects is with the use of LePage's Gesso instead of putty. LePage's Gesso will stick to any surface—wood, metal, glass, etc., and will stand 1000 lbs. breaking strain as explained in the books. It can be sandpapered, planed and painted or stained just like wood. We give you in the small panel below a simple formula for making LePage's Gesso, but of course we tell you more about it in the books themselves, together with practical information on decorating your finished articles with Gesso.

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Name

Street

City

State

Bare Hands

(Continued from page 17)

can't be far away," announced Thornton.

"Let me go," offered Kelly.

"Are you all right?"

"I would be if we had a fire."

Thornton turned to the Aleut who, questioned, revealed that he was Oomak, the man who had been in charge of the yawl.

"Does anybody live on this island?" asked Thornton.

The Aleut shook his head.

"Can you make a fire?" asked Thornton of Kelly.

"I ain't got no matches," replied the sailor. "Never tried without."

"Then go and look for Williams and the other two Aleuts," ordered Thornton. "I can make a fire."

THE seriousness of their predicament was clear to Thornton. Here was a practical problem for him to solve. Obviously he was the one on whom they would have to depend. It put new life into him to realize his responsibility. He was the keystone of this group. He knew it, and accepted the position that Fate had thrust upon him.

"If you find any of them," he ordered, "come back here. I'll get a fire going."

Kelly started off, walking gingerly over the pebbles that hurt his bare feet. Thornton, with equal care, made his way toward the cliff that stood a hundred yards back from the beach. A ravine led down through it, and along the stream that foamed down the gorge grew a few trees. One fallen trunk had been broken, possibly in its fall, or perhaps by a freshet, and lay with one splintered end on a bank of dry sand. Thornton scratched the sand away, and found the wood slightly decayed. He broke off several pieces—large, flat splinters. Then, taking the cord from the waist of his pajama trousers, and breaking a small branch from the tree, he made a stiff sort of bow. Next he found a stick of wood a foot or so long, more or less round, and perfectly dry. Twisting the string of his "bow" once around it, he placed the stick upright, with the lower end resting on the largest of the splinters. The upper end he supported by means of a bit of wood held in his left hand. Kneeling on the splinter and grasping the "bow" with his right hand, he sawed back and forth, whirling the stick like a drill. As he did so, he saw the wood dust collect where the end of the revolving stick bit into the large splinter. For several minutes he sawed. Finally the dust caked slightly, almost as if it had been moistened.

"GOOD!" he muttered, under his breath.

He gathered up his various bits of wood, and searched about for something he might use for tinder. Birds were flying everywhere, and within twenty steps he came upon a nest from which he frightened the sitting mother bird. He took a handful of the dry stuff of which the nest was made, and walking back to the beach, knelt with the bow and the splinters.

(Continued on page 124)



He just couldn't sell

• • perhaps it's comedones

HE couldn't figure it out. He knew his sales talk was good, for he knew his subject from A to Z. Yet buyers wouldn't let him get started. They put him off as soon as they saw him. There was a reason—though he little suspected it was comedones.

It is a misfortune to suffer from comedones—the scientific name for blackheads. What's more, you may not even be conscious of them, though others notice them. Comedones often interfere with business success, for you can't be clean cut and attractive when they are present. Do you wonder why you don't get ahead? Perhaps it's comedones.

Pompeian Massage Cream helps you overcome comedones. It gets in where comedones form, rolls out all the dirt and oily secretions. It stimulates a healthy circulation, keeps the

pores open, and gives you a clean, ruddy complexion.

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After you shave, spread Pompeian Massage Cream generously over your face—and rub. Continue to rub until the cream rolls out. Note how dark the cream looks. That's the dirt that was in your pores.

Don't let comedones form. Use Pompeian Massage Cream every day—especially when social or business engagements demand that you look your best. It means a healthy, wholesome skin. It means more joy in living.



WHAT ARE COMEDONES?

(pronounced kom-ee-dones)
Dictionary definition: A small plug or mass including the excretory duct of a sebaceous gland, occurring frequently upon the face, especially the nose. It is often called black-head.

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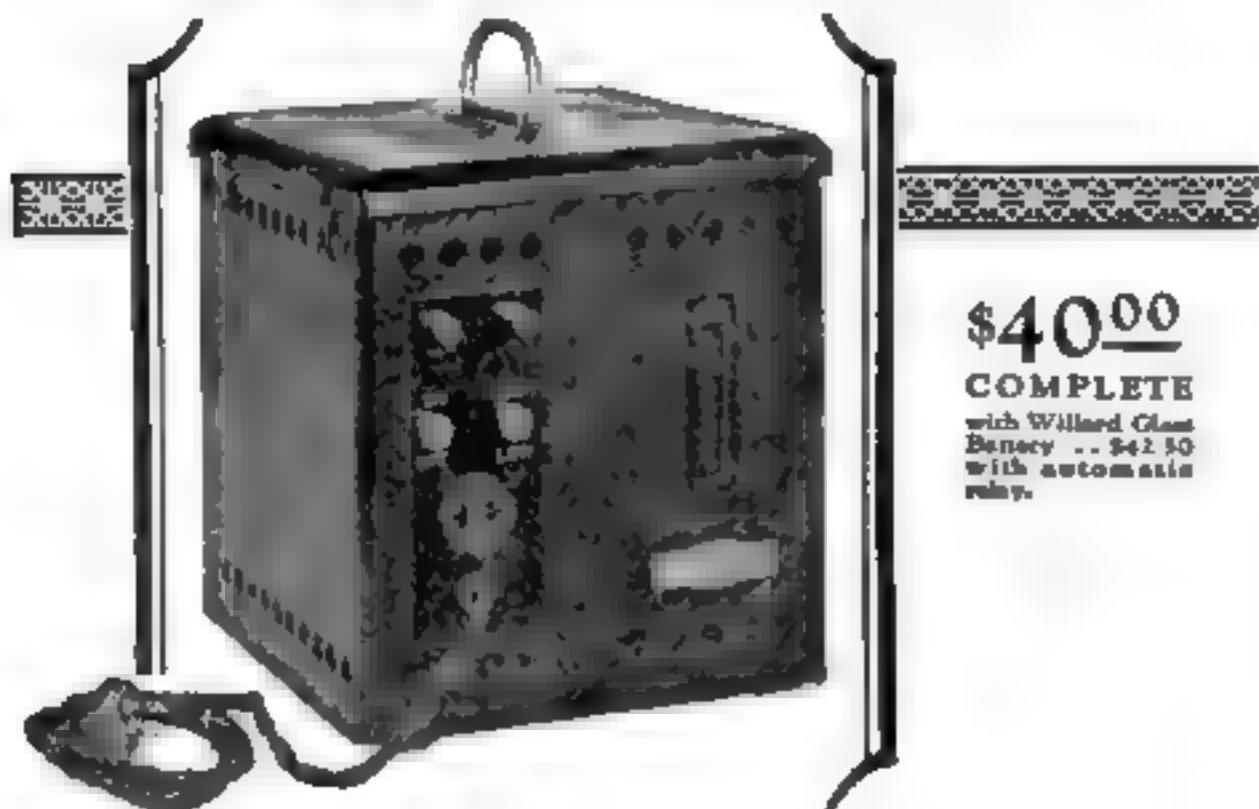
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Bare Hands

(Continued from page 125)

He set to work and sawed back and forth for several minutes. The wood dust caked a little and he paused to fan it gently, but a tiny wisp of smoke was all he got. Again he tried, and again. For half an hour he worked. He saw Parker out of the corner of his eye, walking up and down the beach and swinging his arms. He heard a shout and turned to see Williams a couple hundred yards away with Kelly and the naked Aleut.

ALL of them were slapping themselves and swinging their arms. Thornton himself was almost warm with his exertions, and renewed his sawing once more. Again the dust caked. He sawed a little longer and then bent carefully over the precious grain of fire. He fanned—very gently—and the dust glowed. He blew, and it glowed more brightly. He transferred it to the handful of dried stuff from the bird's nest, and blew again. The pin point of fire grew. He blew harder and a tiny flame burst forth. A few little splinters lay beside him and he carefully built them up pyramidlike over the flame—a pyramid of strands of wood smaller than matches. They caught and blazed. He added others and others still. He burned his fingers and grinned in excited delight, and presently added a larger splinter and another, until he dared put a piece of wood the size of a pencil in the blaze. It caught and flared. In another moment the blaze mounted a foot in the air, and Thornton sat back and fed it with the very tools with which he had made it, carefully salvaging the cord.

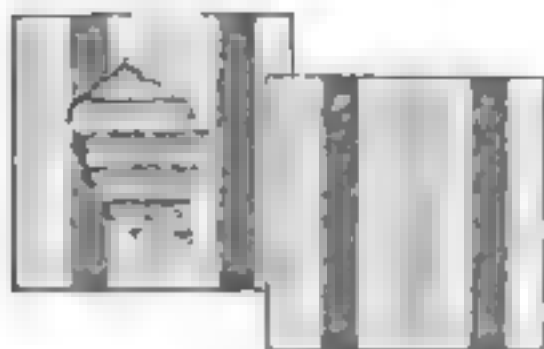
He heard Williams shout, and saw Parker stop swinging his arms and stare. Then, suddenly, the others ran toward him—ran heedless of sharp rocks and tender bare feet and crouched down about the blaze that now was leaping and dancing and throwing out its welcome heat. For that half naked group of men about the fire, the world seemed to center in the flame, and they huddled about it, holding out their hands and saying nothing.

THE whole group seemed pitifully weak and helpless as they huddled about the fire at the foot of the frowning cliff. The island was wild and rugged, with huge boulders scattered about its narrow, fringing beach. Here and there were trees that stood like misshapen giants. A small stream leaped over a series of cataracts in the ravine that cut steeply down through the cliff. Nowhere within sight was there a gentle aspect to the scene. It was harsh—f forbidding—desolate.

Their surroundings affected the group more than they realized. They were accustomed to grandeur in nature, and to beauty, but stark malevolence was new to them, and depressing. Only Oomak seemed not to feel it, for the wild islands of the Aleutians and the Alaskan coast were all he knew.

"I get ptarmigan," he announced presently, getting to (Continued on page 126)

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Bare Hands

(Continued from page 125)

that there are devils here, and as soon as this fellow learned what island he was on, he promptly came back to the fire without any birds. I guess we'll have to get our own. Who'll go with me?"

Williams volunteered, and the two started off in the direction that Oomak had taken. Their feet were tender, and after traversing a few hundred yards over the rocks they were prepared to give up. But they came upon a fallen tree, and plucked pieces of bark from it, making sandals which they laced to their feet with strips of cloth torn from their pajamas. After that they traveled more rapidly, and with more comfort. Birds flew about them by thousands, and they found scores of nests with eggs in each one. A raintail scurried around a rock and darted into a thicket of willow bushes, and ptarmigans foolishly stood their ground, as if waiting to be taken.

IT WAS a simple task to kill the ptarmigans. Thornton got several with a stick he had picked up, while Williams crept up to a nest and killed an eider duck as it tried to get away. Food, apparently, would not be one of their problems, and if there were many rabbits, clothing was assured.

They made their way back to camp, and deposited their catch. The spirits of the party had noticeably improved, and as they sat about the fire and ate the birds that they cooked in the flames, they began to see that their predicament need not necessarily be fatal. They gathered a pile of wood, and found a shallow cave among the rocks—a cave with a wide mouth and a roof that slanted down from the opening to the back. Still it was a sort of shelter, so they moved their fire and set it going before their refuge. They reveled in the comfort that the half-protected spot gave them, for now the heat was reflected down from the slanting roof onto their backs, and they no longer needed to roast to keep from being chilled. Sand, which they carried in double handfuls from the beach, made a more or less even floor, while grass and moss, which they gathered, provided nestlike beds. They sharpened sticks in the fire, after the Aleut had shown them how, and Oomak, who refused to go far from the fire, did go, at last, to a rock midway across the little stream, where he soon speared a dozen fish with his fire-sharpened spear.

THORNTON sat pondering before the fire. He wondered if they would be able to live on this desolate island. Three suits of pajamas and a suit of underwear were all the tangible assets that made them different from the men who lived in the stone age.

"Stone age," he thought, and visualized stone axes, arrowheads and spearheads.

They could get those. And with them they could get food easily, and probably rabbit skins for clothing. They needed clothing badly. They could not go about over the rocks without strapping bark to their feet, and (Continued on page 127)

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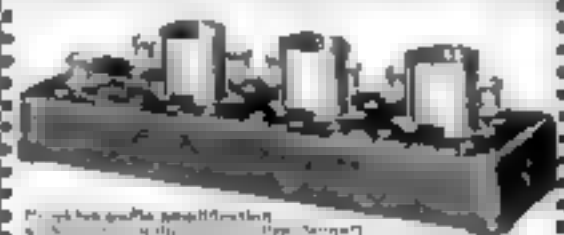
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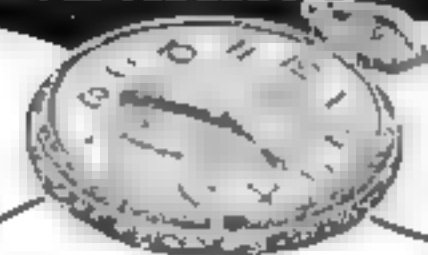
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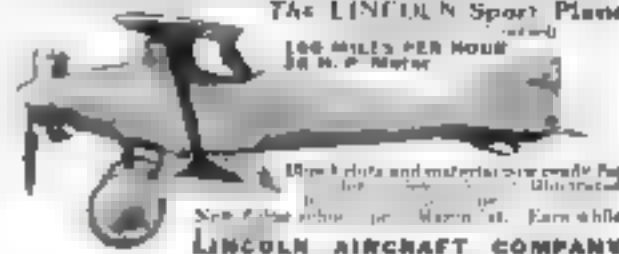
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Bare Hands

(Continued from page 127)

The whole party sat solemnly staring into the fire. A new appreciation of their predicament had come as a result of Thornton's speech. It was serious, and they had much to do in order to save their lives.

What faced them on that island they could not guess. No other land was visible from where they stood, and they felt very lonely and far away.

Naturally the fire was the center of their activities. They went from it for little distances and returned to it promptly. They did not know what might be beyond the boulders, and they felt weak and unprotected. The black rocks frowned upon them. The wind-deformed trees seemed almost like demons ready to attack them. The colorless sea stretched endlessly away to a horizon as devoid of life as any desert.

A BIT of stone fell from near the top of the cliff, and started a miniature landslide down the steep slope. Birds squawked mournfully as they flew swiftly overhead. The breeze in the trees of the ravine whined dolefully. Everything was depressing. They heard a twig snap not far away and sat up quickly. They were alert and alert. Suddenly there came a terrific cry. They shivered with alarm and drew closer together. Oomak groveled on the ground as the cry increased, and Thornton rose to his feet with a bit of firewood in his hand, fiercely determined to protect himself and his friends.

The cry grew louder. It rose and fell echoing from the cliff. Higher and louder it grew, and soared off at last to a piercing shriek that stopped suddenly, almost as if the vocal chords that made it had snapped from the strain. For a moment the weird cry continued to echo from the cliff, and then all was silence again, save Oomak's whispering as he crouched upon the sand.

What was that dreadful sound which pierced the mysterious silence of the desolate island? Was it the cry of human being, beast, or what? Whence had it come? Another thrilling installment of this fascinating novel will be published in next month's issue.

Radio Photos Unmarred by Spots

THE sprinkling of spots, or "freckles," which has been the chief drawback to the radio transmission of pictures by the so-called pen and ink method, recently has been remedied by a new process said to reproduce the original pictures far more faithfully.

This process, as announced by Capt. R. H. Ranger of the Radio Corporation of America, substitutes for pen and ink a fine stream of hot air, shot from a nozzle five thousandths of an inch in diameter. This stream, striking specially treated paper, reproduces the picture at the receiving end. It is controlled by a small valve operated by the incoming signals.

The process, it is said, also eliminates the effect of static, which heretofore has effaced parts of the transmitted picture.



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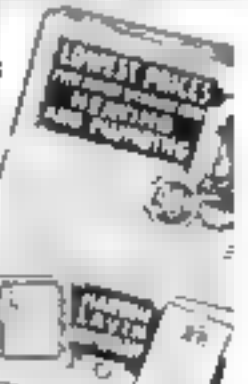
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Make More Money

Read the Money Making Opportunities on pages 134 to 166 of this issue.

Forty Thousand People within Four Walls!

(Continued from page 19)

hazards in earthquakes, hurricanes and fires. They point out that in the California and Japanese earthquakes, buildings of the skyscraper type withstood shocks better than any other kind of structure, while the recent Florida hurricane left the skyscrapers in better condition than other buildings.

Scientific fireproofing and enforcement of rigid safety regulations, they add, have reduced the fire hazard to a minimum. While hardly a week goes by without a small fire in one of the great buildings, virtually every blaze is confined to one or two rooms.

MR. BOSSOM recently offered a fascinating picture of the skyscraper city of the future. Buildings will grow very much taller than at present, he prophesied. Their lowest floors will be devoted to retail stores, all facing arcades. The skyscraper superstructure will extend to the curb line, over the arcades. The full width of streets between the buildings will be reserved entirely for automobile traffic. Such planning will tend, he says, to distribute shopping traffic throughout our cities.

On second floors will be located other shops, banks, and similar institutions. At street crossings we may expect to see bridges over the traffic to enable pedestrians to cross without risk, and without the loss of time. Floors from the second to the tenth will be occupied by offices or light manufacturing establishments. All these lower floors will be illuminated and ventilated artificially. Above the tenth floor level will be hotels, schools, apartment houses, and colleges; and highest of all, where there is abundant fresh air and freedom from noise, will be hospitals.

Theaters and churches will occupy the centers of the big buildings on the lower floors. Basements will be used for bus terminals, garages, restaurants, and other places where people congregate and where natural light is not required.

"CITIES of the future will have hanging gardens," said Mr. Bossom. "Trees will grow six and seven hundred feet above the ground, and bushes and flowers will thrive on setback terraces outside the windows. Men will be able to live healthier and happier lives. The time now wasted in traveling between home and office will be saved for recreation."

Men will continue to build skyscrapers, he predicted, as long as the present demand for them continues.

Nero Played a Water Calliope

INVENTED three centuries before the Christian era, the first "circus calliope" was played with water instead of steam. Italian archaeologists, digging in the ruins near the Golden House of Nero, have brought to light the fact that the Roman emperor amused himself with one of these musical instruments. Water pressure compressed the air to blow the metal pipes, while a network of strings controlled the air valves.



The Other Night on the Radio

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Glenn Curtiss

(Continued from page 150)

married now, with a home of his own. Then in January, 1904, he made his first trip to Florida and on the famous speed course at Ormond Beach established the world's ten-mile motorcycle record of 8 minutes, 54 2/3 seconds, a record which has not yet been beaten.

THAT was a memorable year in the annals of aërial navigation, 1904. It started all over the world at once, the talk about steering a balloon. The gasoline engine had been developed in a dozen countries into the lightest weight prime mover man had yet devised, and everywhere men were speculating on ways of hooking a gasoline engine to a balloon and sailing through the clouds as a ship sails at sea. A man named Deutsch offered a huge prize for the first man to steer a balloon around the Eiffel Tower in Paris, and a young Brazilian, Santos-Dumont by name, built a cigar-shaped balloon with an engine, propeller and rudder, to try for it.

There were rumors that a couple of young men named Wright, who had in Dayton, Ohio, a bicycle shop much of the same caliber as Glenn Curtiss' in Hammondsport, were even trying to fly without putting any gas in their balloon. Of course, everybody knew that you couldn't fly a heavier-than-air machine. Professor Langley's disastrous attempt the year before had proved that so the public thought. If a great scientist couldn't do it, how could a couple of bicycle mechanics? Preposterous! So most of the few who had heard about the Wrights forgot them and turned to dirigibles.

CAPTAIN Thomas Scott Baldwin, of San Francisco, was one of these. He had been giving ballooning exhibitions, parachute jumping, captive balloon ascensions, for years. He knew how to build balloons, but engines were outside his line. One day, somewhere on the Pacific Coast, he saw a Curtiss motor cycle. Its lightweight engine struck him as just what he was looking for. He came to Hammondsport, met Glenn Curtiss, bought an engine from him, then another one specially designed for air work, and on August 2, 1904, the Baldwin airship.

California Arrow" equipped with a Curtiss engine, started out at Oakland, California, and returned to its starting point. Never before had any aircraft been able to do that!

The St. Louis World's Fair had hung up an international prize for the achievement of just that feat. Santos-Dumont brought his dirigible over from France; Captain Baldwin his from California. Santos-Dumont did not start, but the "California Arrow" did—and won the prize.



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New Gifts of Science

(Continued from inside A3)

Observatory, has designed a gigantic new telescope, largest in the world.

The appearance of enormous sun spots, some 125,000 miles long, has probably aroused more interest and speculation than any other celestial event. Mount Wilson observers declare that the sun spots increase the amount of powerful ultra-violet rays in sunlight—a condition that may increase cases of sunburn this summer.

*Anthropology and
Archaeology*

PROOF that ripe old age is a comparatively modern thing has been offered by Prof. T. Wingate Todd of the Western Reserve University from comparative studies of ancient and modern skeletons. He showed that the heaviest death rate in ancient and medieval times occurred at about forty-two years, while the heaviest death rate among adults in modern civilization occurs at seventy-two. Improved conditions of living and greater safety, he found, have greatly increased the span of life since ancient times.

Similarly, by extensive measurements and comparisons, Dr. Horace Gray, of the Institute of Juvenile Research in Chicago, has found that the American boy of today is taller by at least two inches than lads of the same age fifty years ago. This he attributed to increasing knowledge of health and control of disease.

Fascinating facts about early civilizations of the American continent have been revealed in the ruins of ancient Mayan cities of Central America. These included a great sundial built by Mayan astronomers more than 1,200 years ago; and the finding of remains of a great system of stone roads well built by ancient Mayans in Yucatan.

In addition, evidences of a prehistoric Indian race, highly civilized, were discovered in a marshy region of southern Louisiana.

Entomology

THE everlasting battle against insects that destroy our trees and crops has been enlivened by the importation by the Bureau of Entomology of a friendly insect so murderous that it will attack almost any caterpillar. It is being distributed over the country to prey upon the destructive gypsy moth, the brown tail moth and many pests of garden and orchard. At the same time considerable success in controlling the sugar cane moth borer has resulted from airplane dusting of crops with sodium fluosilicate.

That the upper reaches of the sky may be infested with insects that plague the earth was revealed recently by Dr. E. P. Felt, New York State entomologist. By means of traps attached to an airplane, he caught flies and maggots as high as 3,000 feet. Other experiments indicated the presence of insects at still greater altitudes.



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Contest Editor:

After reading over your Money Making Opportunities I pick the full page advertisement on page 113 of your January number of the Chicago Engineering Works as the best and most interesting.

I have noticed this advertisement in the Popular Science for a number of months but never took much interest in it until last month when I received a letter from an old school chum of mine who took L. L. Cooke's course of training and is now earning between \$3,500.00 and \$4,000.00 annually; more than doubling his former salary.

My chum has proven to me that Mr. Cooke's course is reliable—that it's the real stuff. This also has proven to me that POPULAR SCIENCE MONTHLY has nothing but the truth in their advertising each month.

I have already written Mr. Cooke for his literature and application blank, and this will probably be the turning point in my life financially and many other ways.

Henry F. Kobs, Ludysmith, Wis.

Maybe instead of doing things with your hands you prefer to talk to people, to sell them things. Then you will find the story told in the following letter of the greatest interest to you. This is the letter that wins the Second Prize.

Contest Editor:

I have a friend who became a salesman as soon as he graduated from high school. His first job was city candy salesman.

Five years after he began selling, he had made some progress but far short of his ambitions. About this time, he secured a position as assistant state salesman for an electrical company selling to garages, etc. Complaining to me one day of his lack of knowledge of the technical side of selling I suggested he enroll with the National Salesmen's Training Association as I knew, from a personal source, they were reliable. He took my suggestion and, shortly after he completed his course, his company gave him the state of West Virginia as his territory. His salary was \$5,000.

Last September, he was transferred to Texas as state manager of salesmen for his company. His salary is \$9,000 now. In a recent letter to me he said "I'm here, Carr, because of what the N. S. T. A. did for me."

R. B. Carr, Parkersburg, W. Va.

(Continued on page 135)

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How to Save on Plumbing Bills

(Continued from page 28)

be cut in half. The tank closet consumes less water than the tankless flush valve type. A tank float can be adjusted to cut down the water used for each flush. Just bend the float rod so that the float shuts off the intake at the desired height.

Is a dry or chemical closet sanitary?

IT IS prohibited within dwellings in many codes. It involves danger of disease transmission by flies in spite of self-closing covers and careful use. If it must be used, the less objectionable kind is the one with an interior container that is removed and emptied outdoors. There should be a vent pipe to the roof, protected with a fine mesh copper screen, and the air inlets of the outer receptacle also should be screened. The type of dry closet with a metal septic tank below, with or without a mixer device, does not belong within a house.

What are the best materials for fixture receptacles?

VITRIFIED earthenware or "china" for a toilet, while white enameled cast iron is the usual rule for other fixtures. The toilet should be one piece with trap embodied in its make-up and having a flushing rim so that the entire interior is water-cleaned at every flush. The old-time bathtub lined with copper, zinc or tin no longer passes muster. Wooden wash trays and sinks are also banned.

What is meant by open plumbing?

FIXTURES that are open and accessible for cleaning, around and beneath. Water spilled or leaking is unnoticed with a boxed-in outlet and trap. The visible trap gives quick notice of trouble, is handy to clean by plug removal, and can be gotten at for repair of connections. The trap of a first floor bathtub should be visible in the cellar, and it should be easily accessible in a second floor installation. A built-in bathtub is, of course, entirely sanitary, provided the construction is tile or equivalent water-tight material. The built-in effect is obtained ready made, so to speak, in bathtubs of flat bottom, with enameled side and end which fit closely against a wall.


Why do nickel traps, faucets and other fixture details turn green?

BECAUSE the nickel is only a coating which wears off, and brass is beneath. A new and more durable coating for fixture parts is now beginning to be used—chromium, a very hard metal with a luster that looks like silver. Enamel and glass details in a bathroom are, of course, proof against corrosion. This applies to towel rods, shelves, toothbrush holders, soap dishes and the like.

Is brass pipe used throughout in plumbing?

ONLY for water supply to fixtures, not to carry away waste. In water supply lines, brass usually lasts longer than other metal, delivers rust free water and permits the use of smaller pipes because they do not clog or lose capacity by rusting inside. (Continued on page 14)

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How to Save on Plumbing Bills

(Continued from page 143)

In galvanized iron, the least size permissible from curb to house and for most fixtures is half inch, with three eighths inch for lavatory and water closet tank. In brass, the lesser size would do for the whole job except the main feed line. There is a more striking difference when conditions call for three quarter inch galvanized iron. In this case one half inch brass would serve the same purpose.

What are the conditions that demand larger pipe?

ASIDE from water pressure, length of pipe, use of faucet and usage needs, we must allow for quality of the water. A soft corrosive water calls for one eighth inch larger sizes in galvanized iron compared with the sizes just stated, which are based on hard, non-corrosive water. In general, acid waters rust more than alkaline. Atlantic seaboard waters are generally softer and more hostile to plumbing than midwestern waters. Well supplies are usually harder than surface, and their lime deposit tends to protect pipes. But some wells contain carbonic acid that attacks metal, and hardness of water due to sulphate is no protection. Public water supplies are usually soft and corrosive. Science, rather than guesswork, should match water and pipes.

It is not safe to use lead pipe for water, because of the danger of lead poisoning.

Does brass pipe vary in composition and should it be adapted to water quality?

YES. Brass is a mixture of copper and zinc with or without a trifle of tin. The more copper the better the pipe will stand up against salt water, hot water and special impurities. Not less than sixty-seven percent of copper is advised for a hot water line.

Brass pipes do not have the same wall thickness as iron, although "iron pipe size," or I. P. S., is the trade name for brass pipe of correct thickness for plumbing use. The metal in this is about an eighth of an inch thick compared with one twelfth inch for light tubing which is unsuitable. We should specify semi-annealed seamless as well as I. P. S. This gives proper hardness for threaded connections and the pipe can be bent by filling it with hot patch or hot sand.

Does it take more labor to install brass than iron pipe?

MORE care, although the methods are about the same. Expansion of brass must be allowed for, especially with a hot water line, to the extent of one quarter inch for each ten feet. An offset or loop of bent pipe is the best expansion safeguard, while pipe buried in cement should be jacketed with roofing felt or the like to give it freedom of movement. An iron pipe leak will "make itself up" or stop by corrosion, but a brass job must be made leakless the first time. And every good plumbing job uses plenty of unions, drain valves and faucets. This simplifies repairs, avoids freezing trouble and prevents crippling the whole system when one part is out of order.

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FREE BOOK Tells How

Midge

(Continued from page 140)

now stood a heat and a half behind.

A week of trial for the son of Tom Ball—a week of trial for every man on the open hearth as well. And they reacted to the strain of shooting for a record in spite of the terrible weather each man after his own fashion. Pod Horton dripped sweat and grunted—and stayed fat; Bony Carr, the eagle-beaked first helper on Number Three, grew hollow-cheeked and speechless; Jerry Cox and Chuck Sellers, former co-workers on Number Five and now first helping neighbors on Five and Six—even they conversed but seldom and tended solely to their knitting. And down on Number Ten—Butch Bolling.

BUTCH BOLLING was a new man, a powerful brute of a hairy-chested, speared shovel swinger. Brought in to replace Tom Ball Senior, he proved to be a jewel of a steel man except in hot weather, it developed. Then he grew sullen, red-eyed. Pat shook his head when he saw that and passed a quiet tip to Butch's boss, the melter who had charge of furnaces Nine to Twelve.

"Keep yer eye on him," he said. "He ain't sweeten'. He'll blow up, I'm afraid."

Slim Watts, the melter, raised hollow eyes to Pat. Heat gets those long skinny men, and Slim showed it. But he did his work none the less with a loyalty undiminished. He was with all the rest of the crew in his anxiety to break the record and share the bonus that came with it.

"Look," he croaked, and pointed to Number Ten's loading place.

There sat Butch on his warm bench, staring straight ahead of him. And there beside him stood Midge—the kid was known by that name up and down the floor by this time. Midge was handing him, from a sizable basket that stood on the floor beside him, a bottle of pop, cool and sweating. He had lifted off the cap and stuck a straw in it and was making a grunting remark as he passed it over.

BUTCH looked up glowering, snatched the bottle from Midge's hand, tossed the straw aside and drained it in one long gulp. Midge gave a laugh as he stowed the empty bottle away, said something and extended his hand. Butch gave him a surly look, but he got up, reached into his locker and secured a coin which he tossed to him.

"Midge is nursin' him," said Slim. "He ain't made him smile yet—but I notice Butch is always waitin' fer him when he comes around."

That was the job that Midge had selected for himself. Nursing. Errands for Pat, yes, whenever necessary, and frequent contacts with the huge man who in this heat-ridden tension was leading instead of driving, but mostly little things for the men. He had discovered that running errands was the thing most fitting and developed a route that touched every man in Pat's domain, even the lonesome crane operators in their tiny pilot houses. (Continued on page 146)

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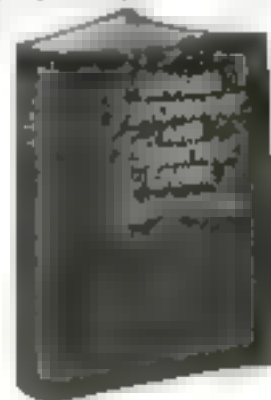
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Midge

(Continued from page 145)

suspended high above the ground on their movable bridges. Pop, candy, cigarettes and chewing tobacco from the restaurant that nestled beneath a bank three quarters of a mile away. He had even gone to town on several trips for the men. Midge? His name was known to everyone, his grinning services accepted gruffly. And when he brought a message beginning with "Pat says—" they obeyed as though Pat himself had spoken.

The men on the charging floor, the shock troops in this battle against a tonnage record, were the ones who deserved—and received—the most attention. And they reacted accordingly.

"Wants to be a steel man," Bony Carr broke his silence long enough to say to Pat. "Little peanut was trying to help me make bottom the other day! He was only shovelin' half loads—not much bigger'n a shovel himself—an' missin' his shot half the time, but he stuck, the little—" a string of affectionate curses.

CHUCK SELLERS, he who had seen his brother dissolved in steel—"He looks somepin' like my—brother," was all he said. Chuck and Jerry Cox were the ones who most often walked home with Midge between them after the day's work was done.

"Askin' questions about steel worse'n any catechism," was Jerry's report. "He learned a lot from his dad—fore he died."

Shrewd old Pat, who had a way of putting men and steel together and getting tonnage, stepped over to Butch's bench after the boy had left.

"Midge botherin' ya any?" he asked. A hot-eyed look from Butch. "Who said he was botherin' me?" he bellowed. "Who's askin'?"

"Nobody," said Pat quietly, "only he's on trial for a week an' it's up today."

"Fire him!" growled Butch. "Fire him! I been tellin' him to get out o' this, that'll be the best way o' makin' him do it. Steel man!" disgustedly. "Wants to be a steel man!"

"Well?" said Pat softly, and left it at that.

PAT knew, he had been a steel man himself ever since he could remember. They cursed their jobs, all of them. But they stayed with 'em. And Butch was no worse than the rest—except that he did his sweating inside.

It was to Butch's furnace that the slump in the record achievement could be traced. Not that he was letting down exactly, but—Butch had had a sticker a few days before. They're not unusual, those stickers. Quite often a heat will lose its carbon before it's hot enough to tap. It only means pigging it up again, adding a dose of cold pig iron that boosts the carbon and raises the temperature—and delays tapping for an hour. But Butch's mood got the best of him. He added too much pig—without consulting Slim, his boss—got the carbon way too high, and tried to ore it down. That was foolish. For ore will speed the elimination of carbon, but (Continued on page 147)

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Midge

(Continued from page 140)

only at the expense of time, and he should have known it. Result: the heat was delayed some three hours—and Butch's temperature had soared until it was equal to that of his furnace. It showed in his eyes.

There seemed to be only one cooling agent for Butch. Midge. Butch was still acting like a lion with a thorn in its foot, but what he had just said to Pat was encouraging.

"Butch told me to fire ya," was what he said to Midge that last evening of the trial week. Pat's shrewd eyes took on their microscope look as he said it.

"**A**W HE didn't," said the kid. There was fear in his eyes and his voice was hoarse. "He never did. He was only a liar."

"And you wanted to be a steel man an' told me to fire ya to keep ya from bein' one?"

"I do," said Midge earnestly. "Ain't I been doin' good?"

"Sure you have, son," and Pat's big hand fell gently on the small shoulder. "Ya been doin' great. Think ya can keep it up?"

"Sure!"

"Think ya can do yer job, an' not be botherin' me fer raises an' things? It'll be a long time 'fore ya're big enough to swing a shovel," Pat warned.

"Sure, I know. But I—I like it. An' I like Butch, an'—all of 'em."

"All right, ya're hired. No shenanigans, now," he hastened to add for the purpose of stopping a burst of that something that shone in the big brown eyes. "Jest ya keep helpin' the boys—an' Butch. An' if things keep goin' like they are, we stand a good chance o' bustin' the record. An' you'll get yer share o' the bonus."

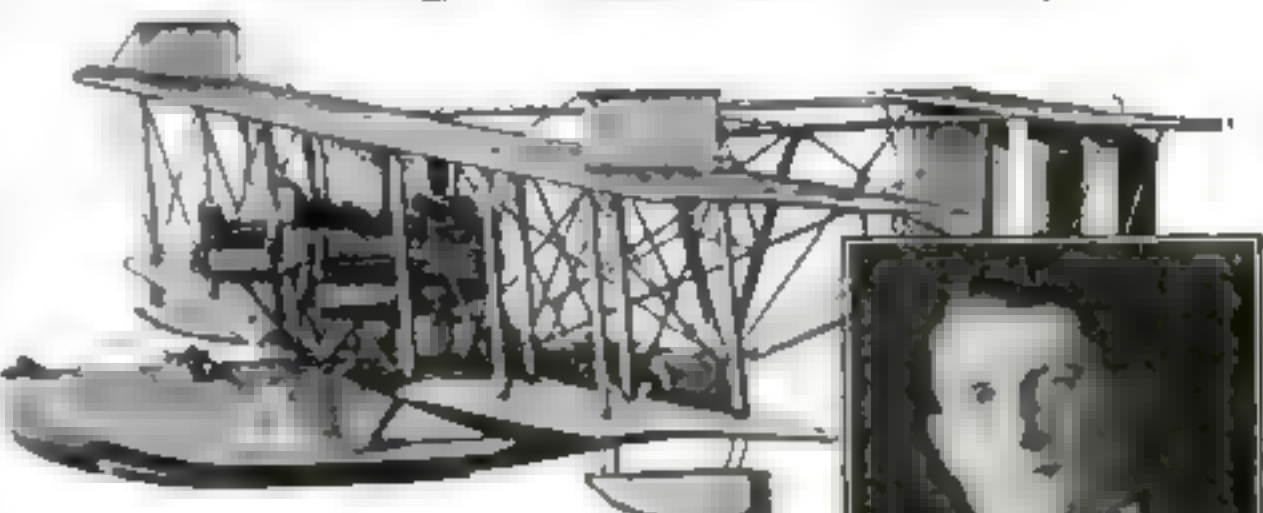
THE ensuing week went by with so little of trouble that Pat, in spite of himself began to wonder about it. The heat continued, bearing down relentlessly on men that deserved a better fate, bottoms were made, furnaces were charged, heats worked and steel tapped as ordered, and slowly the tonnage tapped began to approach the goal for which every man was striving. Midge—he was everywhere, a grinning errand runner. Hot face dripping, his shirt wet, he was the one relieving element in the straining tension of the men. For he was a boy, a brown-eyed, round-faced boy. Not so round-faced of late, for the heat had marked him too, but a boy none the less; one whose grin won him prerogatives that no man could hope for. It was Midge who kept those men from blowing up. Pat was certain of it. Especially was it so in the case of Butch.

"I'm hired steady now," he reported to Butch with great glee as he handed him his pop.

"Huh," growled Butch. "Ya're crazy! Steel! Who wants to work at steel?"

"I don't see you quittin'," retorted Midge—and grinned. Could any grown man have gotten away with that? "I want to be a record buster, like you," a wave of his hand. (Continued on page 142)

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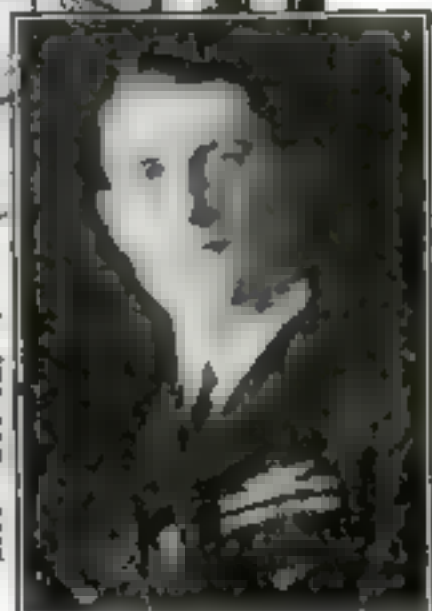
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Midge

(Continued from page 145)

been the calmest, and why if he didn't look out he'd be biting his finger nails! One soft voiced tap had he passed to Sam.

"Talk soft, Sam," he pleaded. "Talk soft. An' don't fer the love o' the record, give orders!"

Slim had nodded silently knowing what was meant. Slim was Butch's immediate boss.

Then Pat had taken a final inspection trip. Not along the second floor level of the charging floor, that could take care of itself from now on, but along the ground level of the pouring floor on the opposite side of the open hearth.

ASINGULARLY quiet and restful-looking place, the pouring floor—except when a river of steel was vomited amid billows of smoke and swirling flame from one of those tapping spouts. A hundred foot boulevard of dry and hard-packed earth, it lies between the half mile row of furnaces and the towering outer wall of the building, the stage where all the terrific labors of the charging floor come to a spectacular climax, the home stretch in this race of men against records. Now it was deserted, idle—waiting.

Ladles? Several enormous ones sat at the rear end of the broad floor near where the mixer made Number Thirteen in the long row of furnaces. Steel-cased, brick-lined buckets three times as high as Pat, two of them to be set by the cranes in their cinder pit nests beneath the tapping spouts of Two and Ten—waiting.

"Spot Number Two first," was Pat's order. "It'll tap before Ten."

Cranes? Two of them, their massive girders bridging the floor high overhead, their tiny pilot houses suspended close to the outer wall, their ponderous hooks—detachable bucket handles—hanging motionless. From each pilot house window a man was leaning—waiting.

INGOT molds? Two trains of them, spotted opposite Two and Ten. Six foot dominoes, hollow and with sloping sides, they stood at attention on dinky flat cars. Their tops, slightly higher than the narrow platform that clung to the wall ten feet above the ground, yawned in black, empty rectangles—waiting.

Furnaces? Cinder pits of Two and Ten clean the condition of the other ten made no difference—tapping spouts set in place above. Number Ten's spout needed a coat of fire clay on its brick lining, but that would be taken care of: the clay and the buckets of water were already in place on the steel balcony that sloped from either end of the furnace toward it. Both balconies were piled with sacks of recarburizer and lumps of ferro-manganese—the stairways that dropped from the aisles—ways between furnaces were unencumbered—waiting.

And Pat? Sitting now in his cubby-hole of an office, drumming with his fingers—waiting. A distant rumble, as of far-away thunder. That would be a crane bringing up a ladle to Number Two as ordered. Number Two was all right; Jack was a good first. (Continued on page 150)



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Midge

(Continued from page 147)

yelling, and handing clay. Slim wetting down more. Midge with his ram, prod-ding—an indescribable confusion—and a trickle of steel ran out of a crack up there.

"Get out!" from Butch.

"Gimme clay! Now, ram!"

Panting, sobbing almost, all of them. And the ladle—crawling like a snail. Pat could do nothing. There were too many men there already.

THE trickle grew in spite of them. Midge scrambled out of its path and stood with a foot on either side of the trough—and packed clay. "Ladle! Pat says ladle!" His voice was woefully weak, but he didn't know it.

The trickle grew in spite of them. It would. No human could stop it. It swelled to a tiny stream—and the dam broke. Just as the ladle swung beneath the spout. Before it had been lowered to rest in the cinder pit a flaming, spitting river of fire was pouring down into it.

Midge, when he saw the futility of working longer, leaped sideways from his perilous position and fell into the arms of Butch. Flame, sparks, smoke. But the steel was going into the ladle.

Butch held the boy in his arms and Pat and Sam took up the duties he should have been directing. Recarburizer and manganese, they tossed them into the stream and Number Ten's heat was tapped. The slag rose over the ladle's rim. Pat gave the order to lift the ladle out and turn it into molds, the crane gears groaned—and then it was time to get the details.

"Heat's O.K.," panted Slim. "Jest got through takin' a test. We'd ha' tapped in five minutes. Was jest goun' after a ladle."

"How's Midge?" asked Pat impatiently. What matter a heat of steel? What matter a record?

Butch gave the boy a mighty hug and set him on the floor. He was shaking like a leaf. Butch was, not Midge.

"Record's busted anyway," said Midge. The little beggar was grinning! "Even if I did steal Number Two's ladle."

A SIGH of relief from Pat. The kid wasn't hurt. Then he gave a thought to what Midge had said. "Jack's got a sticker," he said. "He won't be needin' a ladle till after six. Ya used yer head, son."

"Hot dog!" from a wide-eyed boy who was dancing a jig on the gritty slope of a balcony. "How's 'at, Butch?"

What a boy he was! And what a steel man he would make some day! Pat followed Midge's glance toward where Butch was, still shivering.

"Ya had baked prune!" Butch growled it through chattering teeth. "Ain't got no sense at all! M'ght ha' kuled ya!"

Butch's eyes were still craven with fear—for Midge. Butch's voice was shaking. The boy had unwittingly done something that even Pat could never have done. He had turned a near-lunatic into a steel man. For Butch—was sweating!



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The World's Woodpile

But after all, there is still a vast amount of wood which so far has found no use unless distinctly altered in form. Wood that goes into the manufacture of charcoal is an example. By the modern method of making this valuable product, the gases are saved and condensed, and from various woods such valuable by-products as wood alcohol, acetic acid for dyeing, acetone (used in the film industry), creosote and pitch are obtained.

From soft woods containing pitch and resin, especially in the roots, knots, stumps and branches, distillation yields wood turpentine, pine oils, tar oils and charcoal. Some 200,000 cords of wood are said to go into such purposes annually, and because most of this wood would otherwise be burned, the nation gains economically.

GLUCOSE and **lignose** also are extracted from wood. At the Forest Products Laboratory of the University of Wisconsin an edible stock feed has been produced, utilizing the cellulose and glucose, or wood sugar. Stock fed on this, in place of one third of their usual grain ration, are reported to have thrived. So perhaps we are not so far, after all, from breakfast food of sawdust or shavings.

In Los Angeles there is a plant which makes glucose from wood waste, by treating with dilute hydrochloric acid gas and steam. The process is completed in one and one fourth hours, and the product is then ready for packing and distributing as a cattle food. The process is said to yield, in addition, sixty five to seventy gallons of grain (ethyl) alcohol per ton of sawdust. The usual yield, however, is around fifteen to twenty five gallons per ton.

Still another fruitful field is in the manufacture of wood alcohol, made largely from hardwoods. The wood is reduced to cellulose by treatment with ether, diluted acids, such as nitric or hydrochloric, and alkalis, the fermentable sugar and alcohol are then readily prepared. A French process recently developed is reported to obtain about twenty-two gallons of this useful industrial material per ton of sawdust.

FEW inventions have changed the trend of the times more than that of grinding wood pulp. Only quite recently practically all paper was made of rags, cotton and linen, hemp, flax and jute, ground up and chemically treated to make a pulp. Today all newspapers are printed on newsprint made very largely from wood ground very fine. A fortunate circumstance is that ground pulp may be made from crooked, defective and otherwise unusable wood. Almost ninety percent of all the paper we use now is made of wood pulp with varying proportions of rags and old paper.

Mixed with glue, wood pulp and wood flour can be made into papier-marché products, such as ornaments, statues, cornices, picture frames and boxes. From a waste utilization standpoint, ground wood is an ideal material, because it can be recovered and (Continued on page 154)



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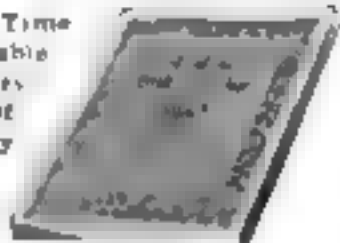
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Your Car Is As Old As You Make It

(Continued from page 144)

car." Gus answered. "is a whole lot like finding out what is the matter with a human patient when he comes into your office. First thing you do is ask the patient what he does for a living, so's you can get a line on what's most likely to be causing the trouble. You said you were a doctor. Then you study the patient's complexion, feel his pulse, sound out his lungs, and make him hop around. I looked for neglect of lubrication and found it. Then I speeded up the motor, and I could hear a shuffling rattle that indicated pistons worn too loose. There was a dull thump that told me the center main bearing wasn't as tight as it ought to be, and short-circuiting the spark plugs tells a story of poor compression, leaky valves and loose connecting rods.

"I APOLOGIZE for speaking hastily," I said Doctor Holmes. "You see, I bought this car after I had used a cheap car for several years. I had had trouble right along, and now I thought if I bought a good car it would give longer service without going to the repair shop so often.

"That's what a lot of people think, and they're all wrong," Gus asserted positively. "A high grade car will last longer than a cheap one only if it receives good care. Neglect sometimes will cause more trouble with a good car than with a cheap one, just because the working surfaces on a good car are fitted closer and wear a lot more because they get so hot when the lubrication goes bad."

"Then you would advise a cheap car for my use?"

"Not at all, Doctor," replied Gus. "Only I'd suggest that if you don't want to do the work of taking good care of your car, you'd better arrange with a reliable service station to go over it once every two weeks or a month and see that it is kept in adjustment and lubricated properly. Of course you can't expect any car to last forever on the kind of use a doctor has to put it to, but it ought to go ten thousand miles before it gets as bad as it is now after only five thousand.

YOU can do a lot less to cut down the extra wear caused by so many stops and starts. Use the choke just as little as possible. Throw a blanket over the hood when you are only going to stop for a few minutes, so the motor won't get stone cold. Let it idle slow a few moments each time you start it up before you throw in the gears and drive off. Putting your brake on more carefully will make the brake linings last thousands of miles more than you got this time. And don't forget that the best oil you can buy is none too good for a fine gasoline motor. That's my course of treatment, Doctor."

"All right," agreed Dr. Holmes meekly. "I'll leave the car here tonight, and you get it back in shape as soon as possible. Then I'll try to keep it that way." "Gosh!" exclaimed young Sanson, who had been hanging around taking in every word. "You sure made the old boy climb off his high horse!"



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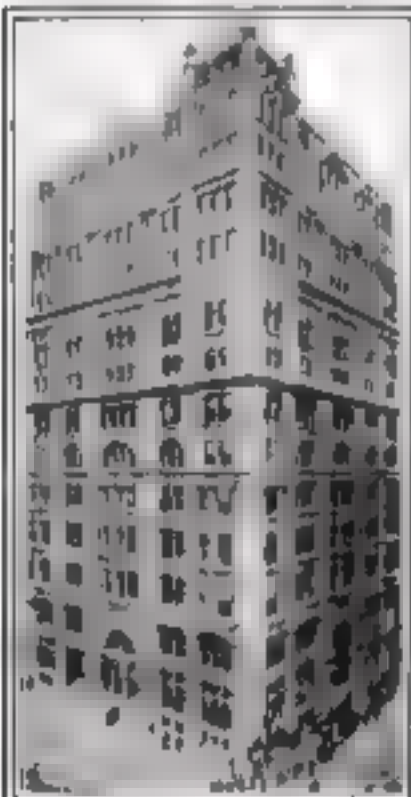
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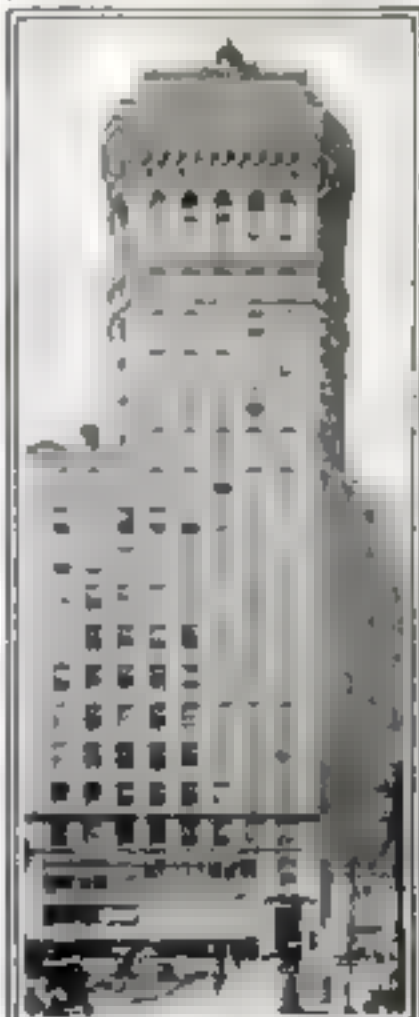
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Advice for Popular Science Monthly readers regarding safe and profitable investments. See page 1.

Why Some of Us Can't Stand Cats

(Continued from page 45)

with the goods. "Miller's asthma," which afflicts workers in flour mills, has been traced directly to flour dust infected with certain microscopic mites; and the same disease has thus been artificially produced and studied in animals.

In all these tests antibodies were produced artificially in the living animals. Are idiosyncrasies, then, absolutely a question of individual luck, and does heredity play no part? If tomatoes make your parents violently ill, can you eat them with impunity?

INGENERAL yes. There are some cases of inherited idiosyncrasies, but these are usually vague tendencies rather than specific aversions. No one is born with antibodies. Two American scientists, Drs. R. A. Cooke and A. Van der Veer, made these conclusions after a study of more than five hundred persons with idiosyncrasies. In only thirty-nine of these cases did they find both parents possessing the same trait; in 205 cases, one parent exhibited the peculiarity. Of the remaining 260, neither parent had ever had the trait in question. Also, the scientists were led to believe, if both your parents had a certain idiosyncrasy you would have acquired it, if at all, during the first five years of your life. If only one parent was susceptible, you would probably pick up the trait between the ages of ten and fifteen, while if both parents were entirely normal, your "dangerous age" for acquiring susceptibility would be between twenty and twenty-five.

Now that we have a fair knowledge of how an idiosyncrasy works, scientists are offering us more hope for a cure. Prof. Oscar M. Schloss, child specialist and research worker of New York City has actually succeeded in curing certain susceptibilities in his patients.

One of these was made extremely ill every time he attempted to eat eggs. Dr. Schloss prescribed ovomucoid, a preparation from the whites of eggs. The small quantities of the first doses and the fact that it was swallowed, not injected, avoided ill effects while it gradually destroyed the antibodies in the man's system. Eventually, Dr. Schloss reports, the patient was able to eat eggs at will with no untoward consequences. In the same way, a patient susceptible to certain protein or tissue-forming foods was cured.

HAY fever has been one of the first idiosyncrasies to yield, at least temporarily, to modern treatment. Clinical tests are now made to identify the particular kind of plant pollen responsible; a salt solution is then made of the pollen, which, injected in the skin, gives immunity from hay fever for one season.

So perhaps the time may come when you can eat all the cucumbers you want, if that happens to be your weakness. In the meantime, don't let anyone make light of your troubles. He wouldn't feel any too good, either, if his insides were being blown up.

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A Thirteen-Year-Old Explorer

(Continued from page 47)

animals had proved the most interesting study of all to him. Eskimos told him bears play tag sliding down icebergs the way boys at home slide down haystacks. The young seals, though water animals, are terrified at the water when they are young. And so on. He described enthusiastically one successful hunt for bears.

"From our schooner, the *Morrisey*, we captured some young polar bear cubs. They were actually roped by our cowboy, Carl Dunrud. We found them, with their mother, a great polar bear, out on an iceberg, floating around about twelve miles from shore. I never knew before that polar bears are quite as much at home in the water as they are on land. In fact, the Eskimos say that the bears can swim just as far as they can walk. There are records of their having swum several hundreds of miles.

"I WAS surprised, too, to learn that blue foxes and white foxes are the same animal. Nobody seems to know why some are blue and some are white. Greenland foxes live by robbing birds' nests of the eggs. That is one of the reasons why the bird rookeries are down on the sides of cliffs. Birds make their nests where foxes can't get at them.

David had made some curious discoveries about the northern sea animals, too. The narwhal, for instance, has two tusks, though only one of them grows, this one being sometimes as long as twelve to fourteen feet, and a walrus has two tusks which he uses to dig up clams from the bottom for food. But a seal has no tusks, nor has the white whale, both being very peaceful animals. He told how many sea birds, such as gulls, auks and ducks, breed in the far North, how every year a number of these birds are born mentally deficient and lack that touch of instinct which makes their brothers fly South when the dark Arctic winter comes on.

"THE more I think of it," David exclaimed, "the more I realize how much a real naturalist gets out of life. The world is a wonderland of strange things. It's wonderful to see a bee's house and watch the way the bees work, or to watch birds building a nest on a swaying branch of a tree. That is really a harder job in architecture and construction than for trained men to build a big building."

Strange Explosive Mineral Found

A FEW weeks ago Dr. W. F. Foshag of the Smithsonian Institution was exploring a silver mine in Durango, Northern Mexico when he was startled by a series of sharp explosions that ripped great gaps in the walls of the mine tunnel. The blasts, he found, were produced by a rare mineral which explodes, like a stick of dynamite, the instant it is mined from the rock.

The name of the mineral is Hillebrandite. Its explosions are believed to be due to sudden bursting when it escapes from high pressure in the rocks.

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12. This description applies reasonably well to the fluid inside the coconut. Of course, this fluid is not exactly the same as animal milk, but it has many of the same properties and is almost equally valuable for food.



This One



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Strangest Factory in the World

(Continued from page 59)

ing. In this machine a piece of first rate sole leather will lose two ounces in weight in two hours. That is the equivalent of about three months' ordinary wear. How do we know that? Because the speed with which our machine wears out leather from every part of the hide has been compared with the speed with which policemen, mail carriers, soldiers and others wear out the same leather in daily use.

In our rubber laboratory we test your automobile tires by revolving them against metal drums operated by big electric motors. These drums are about three feet in diameter with tread about eight inches in width. Attached to the tread are metal cleats or knuckles, which correspond to road bumps.

THE tire is brought against the drum under pressure which corresponds to the weight that the tire carries in service—eight hundred pounds or so. Under these conditions, running at a speed of thirty miles an hour, the tire tells its own story. A poor tire may blow out after it has run eight hundred miles. Other tires will stand up for twelve hundred and fifty miles on the drum. This we have found to be the equivalent of between eight and ten thousand miles in ordinary service.

When an automobile equipped for one of our road performance tests drives away from the Bureau, it certainly is a curious sight. On one side sticks out an apparatus that looks more or less like a smokestack. In the seat beside the driver, in the tonneau, and attached to the engine are numerous mechanical devices which record everything that happens during the run—the acceleration, the speed, wind speed, the pressure in the manifold, temperature of the water outlet, of the oil, carburetor, air, transmission, lubricant, fuel, and even the weight of the air used by the engine—in all, sixteen items of performance, each of which is vital to the car's efficiency.

Tests of this kind have brought to light facts as surprising to automobile manufacturers as they were to us.

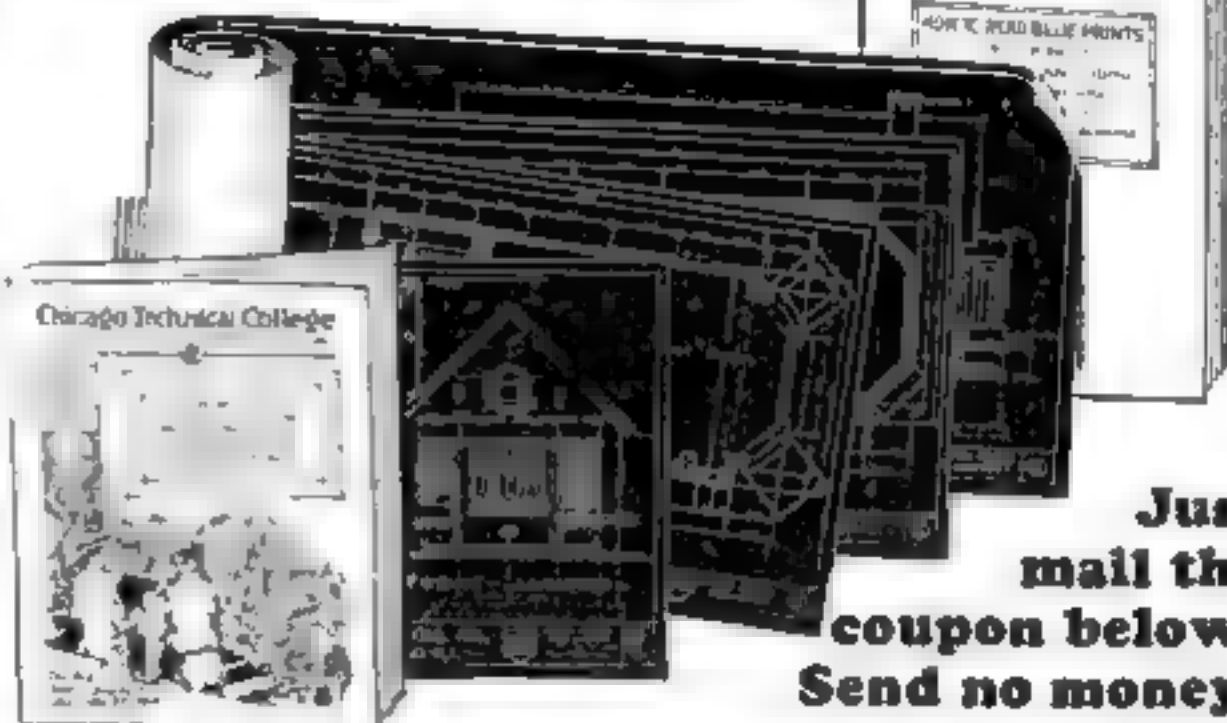
FOR example, how much of the energy in your gasoline tank do you think actually gets to the rear wheels to push your car over the road? Between fifteen and twenty percent, these tests have shown. The rest is used in overcoming wind resistance and the internal friction of engine, transmission and bearings.

Again—you would probably guess, off hand, that an open car offers less wind resistance than a closed car. The reverse is true.

Most drivers seem to think that from the point of view of gasoline consumption the most economical speed is a fairly high one. Owing, however, to the great increase in wind resistance at the higher speeds, you actually get the most miles per gallon of fuel when running between fifteen and twenty miles an hour, according to these tests.

For least wind resistance and hence economy in operation, the average person would say a car. (Continued on page 162)

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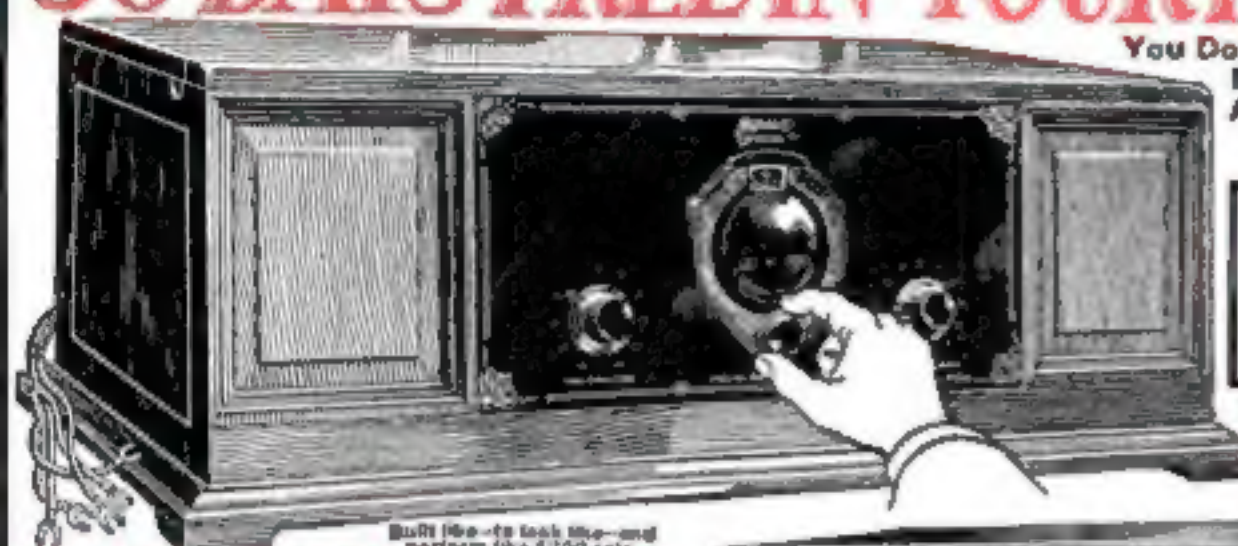
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burgh. Heard other stations in Illinois, Nebraska,
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sas, California, Catalina Island, Utah. C. D.
KIAKEL, Sterling, Colo.

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Having owned and operated over 50 radio receivers,
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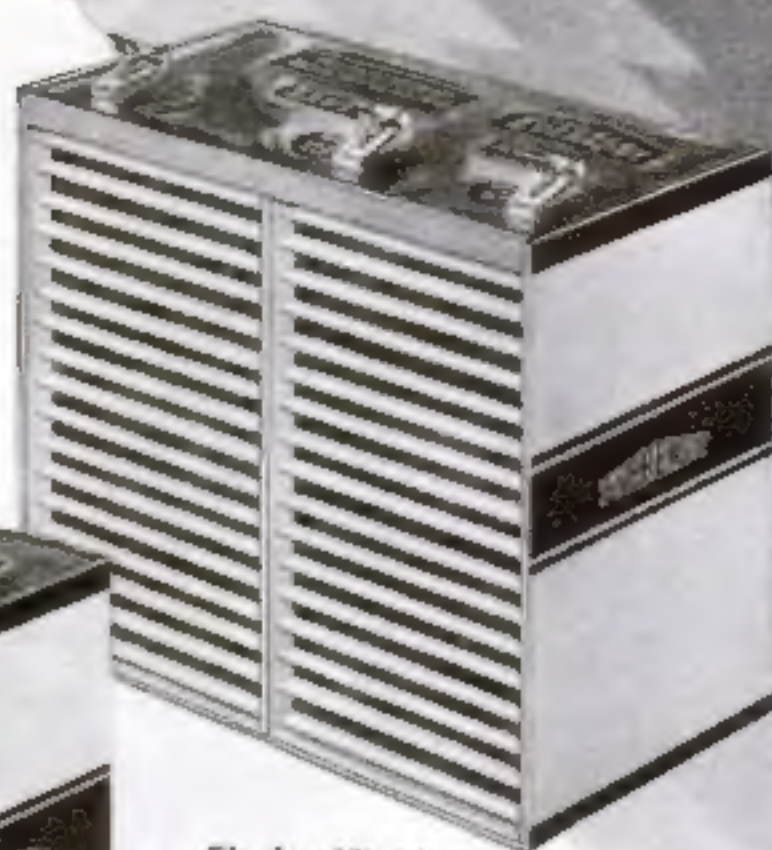
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